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DEPARTMENT OF THE ARMY FIELD MANUAL

CAMOUFLAGE MATERIALS



DEPARTMENT OF THE ARMY

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No. 5-22

DEPARTMENT OF THE ARMY
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*This manual supersedes FM 5-20H, 1 July 1944; TB ENG 152, 21 December 1954; TB ENG 153, 23 December 1954; and so much of TB ENG 50, 11 November 1944; FM 5-20D, 9 February 1944, including C 1, 14 January 1955; and FM 5-20F, 1 May 1944, including C 1, 17 January 1955, as pertains to material covered herein.

CHAPTER I

INTRODUCTION

1. Purpose

This manual provides a guide and reference to the materials that may be used for camouflage and furnishes instructions in methods and techniques of field fabrication. It is intended for the use of troops wherever information concerning camouflage materials is required.

2. Scope

This manual describes and lists natural, artificial, and expedient camouflage materials and field manufacturing methods and techniques. Not all of the camouflage materials issued have been listed, nor have all of the reported field-expedient materials or devices been included. A list of camouflage materials available for issue is contained in Department of the Army Supply Manual ENG 3-49, discussed in paragraph 3c below ; and in the field, ENG 3-49 is available in the headquarters of engineer companies and higher units. Field-expedient materials and devices are, by definition, those which are adapted to suit local needs, and they are as varied as the local conditions which require camouflage efforts. It is not within the scope of this manual to discuss camouflage methods or techniques. This information is given in the camouflage series of manuals, and it is the responsibility of the user to familiarize himself with these manuals. He then will be able to make his own selection of the camouflage materials required for the particular situation.

3. How To Use This Manual

a. Organization of Manual. The table of contents gives the basic arrangement of the material in the manual. It should be noted that camouflage materials are discussed or grouped according to purpose and use. Thus, hiding and screening materials are listed in chapter 2, coloring materials in chapter 3 and texturing materials in chapter 4. Where a material may be used for a dual

purpose, it is discussed in only one chapter. A list of references to other camouflage literature is included in appendix I. Tables of useful camouflage data have been grouped for easy reference in appendixes II, III, and IV, and a glossary and an alphabetical index are provided at the end of the manual.

b. Obtaining Materials for Camouflage. This manual provides data on various materials which have been found most useful in the solution of camouflage problems. Throughout the manual, wherever an item of camouflage material is described, information is given as to whether it is an issue item and listed in supply manuals, or whether it must be obtained from other sources. The only limit to the availability of materials for camouflage is the ingenuity of the camouflage personnel concerned. Materials may be found at the site (natural vegetation, gravel), may have to be manufactured (paint from pigments obtained from crushed rock), or may be purchased ready to use (bolts of burlap for screening purposes). The Department of the Army supply manuals are valuable references which list issue materials, and which can be used to obtain information on their composition and fabrication.

c. Department of the Army Supply Manuals. These manuals are the Army's media for disseminating item identification and information on the supply of the items. Manuals are issued by the various technical services for their own items. The manuals are designated by symbols for the issuing services, for example, ENG for the Engineer manual, QM for the Quartermaster Manual, and so on. They are further broken down into numerical and sub-designations, to indicate the type of information they contain.

- (1) ENG 1—Introduction to the Department of the Army supply manual system as applicable to the Corps of Engineers, together with an alphabetical index to all engineer supply manuals.
- (2) ENG 3—A series of catalog type manuals with each one listing the items of a specific federal standard class of general engineer supply which are available to meet requisitions; for example, ENG 3-4⁵ lists camouflage materials, ENG 3-52 lists paints and paint ingredients, and so on. In addition, ENG 3-100 provides an alphabetical cross-index of all ENG 3 supplies to each Federal Standard Class Catalog in which the items are listed. ENG 3-101 provides valuable weight and cubage logistics for ENG 3 items on which such data are available.
- (3) ENG 5-2—This is a pricing index which lists by stock number the items found in ENG 3 and their average or estimated price.

- (4) ENG 6—This manual lists the various sets of equipment issued by the Corps of Engineers, together with data on the stock number of each set as a whole and the stock number of each component of the set. Weight and space dimensions are also included. For more detailed information on the operation of the supply manual system, see ENG 1.

d. Specifications and Standards. It should be noted that the standard item nomenclature used in Army supply manuals contains a reference to the specification under which the item was procured. These specifications, and the drawings to which they refer, are available to contractors and will prove most valuable guides to the fabrication in the field of similar but improvised items, since they contain accurate useful information on construction details, materials, physical requirements, coatings, etc., which are considered essential in the issue item. Major military headquarters maintain an index of specifications and standards used by the Department of the Army.

4. Terminology

Certain terms used in this text to describe or explain material peculiar to the subject of camouflage are discussed in the glossary at the rear of the manual.

CHAPTER 2

HIDING AND SCREENING MATERIALS

5. General

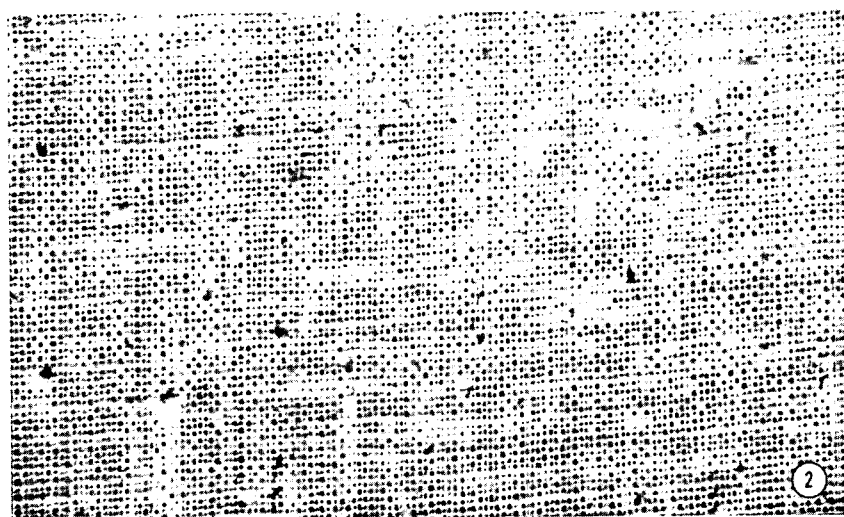
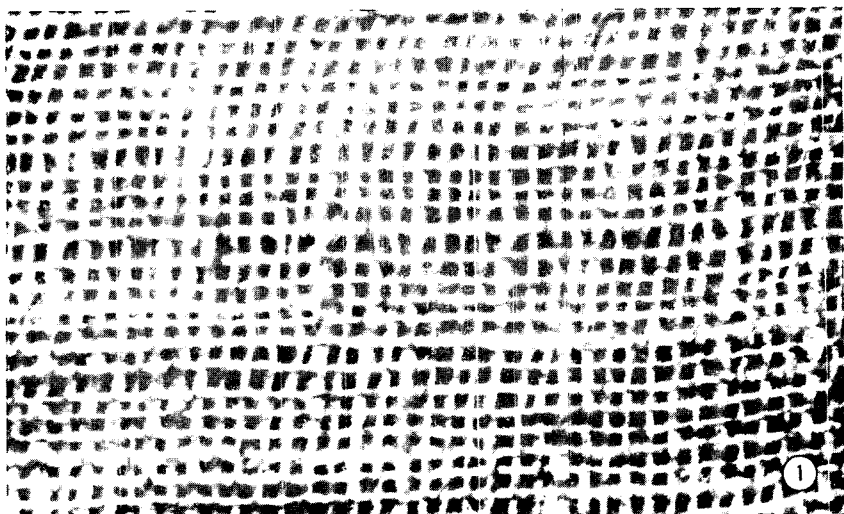
The materials discussed in this chapter are those used for covering or hiding three-dimensional objects or forms. These materials consist principally of screens and screening materials. However, no single material or method usually will satisfy all of the requirements for adequate hiding. In addition to screens or screening material, adequate hiding may require texturing, coloring, or the use of camouflage materials, as described in the following chapters. Locating the object or activity so as to take advantage of available natural screens will lessen the need for applying hiding techniques and materials.

6. Cloth

a. General. Cloth and cloth substitutes and expedient materials make excellent screens and usually are easily obtainable. Colored impregnated issue cloth is mildew and flame resistant and has controlled infrared reflectance. Coloring of cloth is described in paragraphs 15 and 16, and the use of cloth as garnishing material is described in paragraphs 24 and 25.

b. Burlap. Burlap is a coarsely woven material made from jute or kenaf fibers (1, fig. 1). It is issued in bolts 40 inches wide and 100 yards long, and in olive drab, sand, and natural shades. Issued in bales, each bale contains 2,000 yards. As a garnishing material, it is issued in rolls 2 inches wide and 100 yards long, in all standard camouflage colors including black and white. Figure 2 shows use of burlap as a temporary screen.

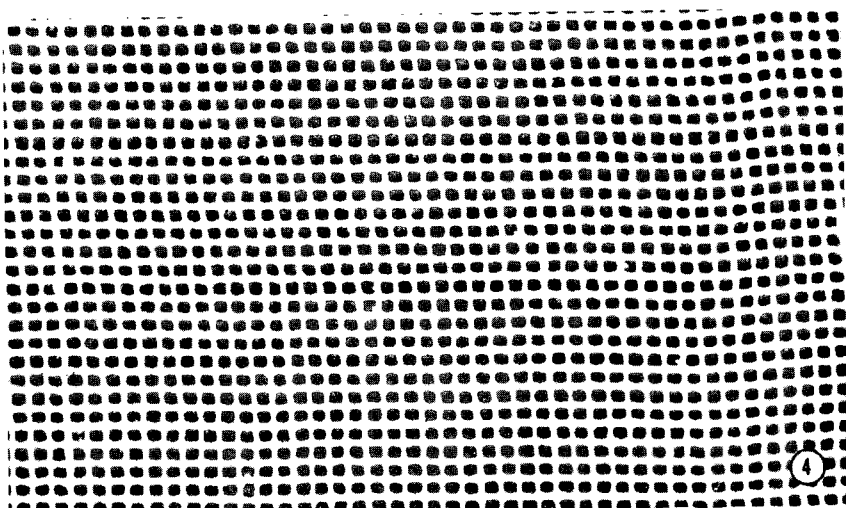
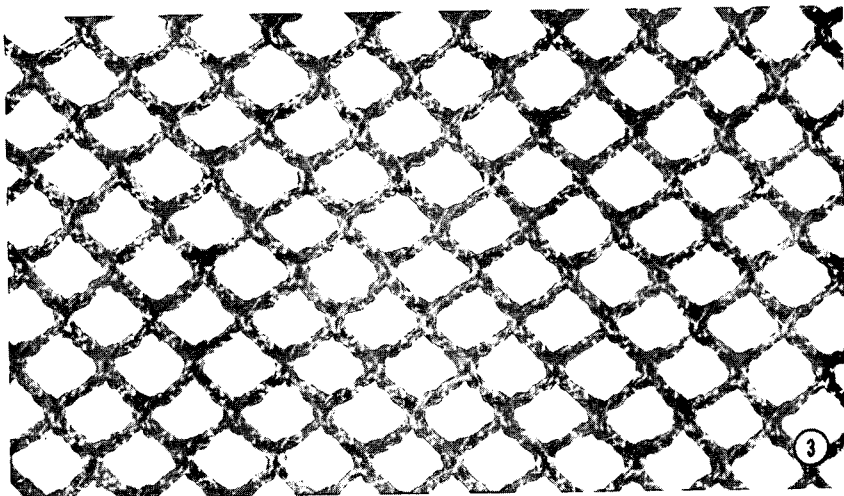
c. Osnaburg. Osnaburg is a cotton cloth more closely woven than burlap (2, fig. 1). It is commercially available in natural color in bolts 40 inches wide and of variable lengths. In bales, each bale contains 1,000 yards. For garnishing, osnaburg is issued in rolls 2 inches wide and 100 yards long, in white only. Figure 3 shows use of cloth as an overhead screen.



- 1 Burlap cloth, actual size
- 2 Osnaburg cotton cloth, actual size

Figure 1. Cloth used for screening material.

d. Cloth From Local Sources. In a theater of operations, many types of cloth may be found suitable for screening material. Sources are military depots, salvage depots, local weavers, textile mills and abandoned homes. Clothing, sacks, blankets, draperies, bedspreads, and tablecloths are useful materials. The coarsest materials should be selected.



3 Example small-mesh (shrimp) netting, actual size.
4 Scrim, actual size.

Figure 1—Continued.

7. Cloth Substitutes

There are many areas throughout the world where local materials make excellent cloth substitutes.

a. Small-Mesh Nets. Previously a standard issue material, it is now obsolete. These nets are of knitted cotton fabric, with meshes from $\frac{1}{4}$ to $\frac{5}{16}$ inch square (3, fig. 1). Local lace manufacturers may be able to produce a similar fabric.

b. Scrim. Scrim is a small-mesh material similar to mosquito netting (4, fig. 1). It usually is supplied in 39-inch widths and

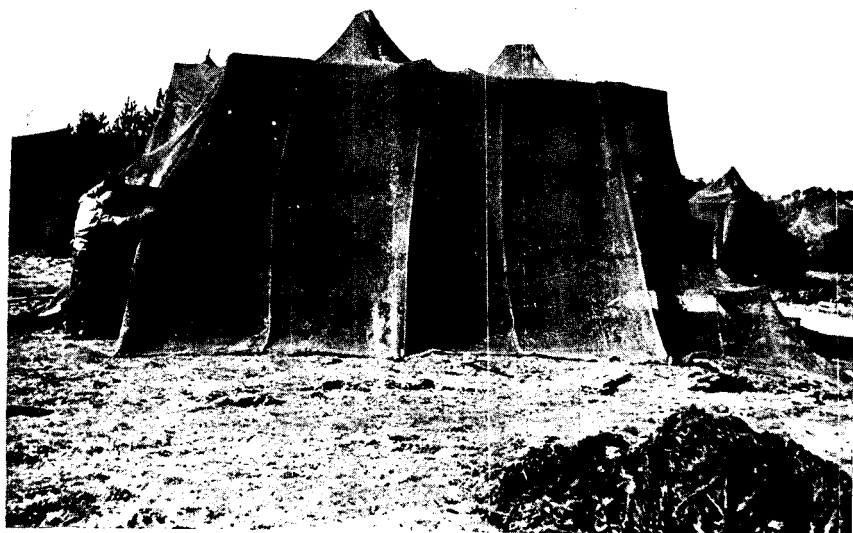


Figure 2. Burlap used as a temporary screen.



Figure 3. Cloth draped as overhead screen in erection of a camouflaged aircraft shelter.

is normally light yellow in color. Sources are theatrical supply houses, textile lace manufacturers, and retail stores.

c. *Mosquito Netting*. Mosquito netting is obtained from commercial sources in temperate and tropical areas.

d. *Woven-Paper Netting*. Woven-paper netting is similar to shrimp netting and is made of strong, impregnated paper. It may be obtained from manufacturers of sacking materials.

e. *Chen-Chen*. Chen-chen is a durable wood-fiber cloth obtained in West Africa. It is made in sheets of 6 by 8 feet.

f. *Palm-Matting*. Palm-matting is made in many tropical areas in any specified size.

g. *Roofing Paper and Cardboard*. Roofing paper and cardboard are limited cloth substitutes. They lack the desirable textured quality and flexibility of the cloth substitutes described in a through f above.

8. Nets and Netting

a. *General*. Nets and netting of the large-mesh type are used extensively for screening materials. They are of no value for concealment unless the openings are filled in and textured with garnishing materials. Garnishing materials and methods to accomplish this are described in paragraphs 25 and 26, as are coloring materials and methods in paragraphs 15 and 16. Large-mesh nets of twine and netting of wire are issued either garnished or ungarnished. The design of the nets makes them adaptable for use in nearly all types of terrain, but they are useful particularly in concealing weapons in barren or desert areas where natural aids to concealment are lacking.

b. *Twine Nets*. Large-mesh twine nets are used as individual camouflage drapes for equipment, as component parts of camouflage net drape sets, or as covers for flat-tops in temporary installations. They are issued in various sizes (table XXVII, app. III). Old issue nets or those found in captured stores may have a diagonal mesh. These have a tendency to pucker and become irregular in shape, requiring more intermediate support than the present issue nets which have a square woven mesh. Twine nets characteristically shrink when wet and expand when drying out. If destroyed or lost, substitutes may be found in captured stores, salvage or friendly forces, or fishing nets purchased or requisitioned from local fishermen, seiners, or manufacturers. In some areas local labor may be employed to manufacture nets from native materials. The use of netting and net drape sets for screening is shown in figures 4-9.

(1) *Color blends*. In order to provide for blending nets into a variety of seasonal and geographic terrain character-

istics, all garnished nets are stocked and issued in four color blends:

- (a) Tropical and summer temperate.
- (b) Winter temperate.
- (c) Desert or arid areas.
- (d) All-seasonal.

The percentages of garnishing strips of various colors which together make up each color blend are found in paragraph 25*d*.

(2) *Drape nets.*

- (a) Garnished twine nets, designed to provide concealment for individual vehicles (tanks, trucks, trailers, and so forth) and similar size installations, are garnished in a pattern different from the patterns of other nets. When propped and supported over, but not touching, the equipment they conceal, drape nets provide an effective screen from both air and ground level observation. The low silhouette and gradual side slopes made possible by their use eliminate sharp telltale shadows which are usually the most important factor in ground-target identification from the air (figs. 4 and 5). Drape nets, as well as net drape sets, are used to conceal not only weapons but their entire emplacements from all angles of observation. This is necessary because every weapon has a characteristically shaped emplacement which is easily detected and identified, especially from the air. Thus, the critical factor in determining the size of the drape net to be used for a particular weapon is the emplacement rather than the weapon itself.
- (b) The scarred area in the immediate vicinity of the emplacement, created by bulldozers in scraping the earth to build up parapets, also must be covered for effective concealment. Freshly turned earth usually is brighter than the untouched surroundings and can be detected even through the garnishing of a drape net, especially when the nets are suspended close to the spoil. When the earth is covered or toned down by colored tarpaulins, sandbag burlap, vegetation or other suitable material, it becomes relatively inconspicuous.
- (c) In circular emplacements, the area outside the pit beneath the drape set can be used for foxholes or ammunition storage. Support poles can be con-

veniently placed in these areas to provide head space and approaches to the pit. In rectangular emplacements, the side area outside the pit also can be used for this purpose.

- (d) The technique used in garnishing drape nets is discussed in paragraph 25c. The garnishing pattern to be used for drape nets is shown in 1, figure 68. For sizes, weights, cubages, and number of garnishing strips to be used see table XXVII.



Figure 4. Net drape sets screening gun emplacements (within circled areas).

- (3) *Flat-top nets.* Garnished twine nets to be used as covers for flat-tops are garnished in a distinctive pattern. They do not provide concealment from ground observation, since the entire net is supported in a horizontal plane over equipment at a uniform height from the ground, and no provision is made for concealment from lateral or low-oblique observation. Techniques used in garnishing flat-top nets are discussed in paragraph 25c. For sizes, weights, cubages, and number of garnishing strips to be used see table XXVII.
- (4) *Camouflage net drape sets.* Camouflage net drape sets consist of pregarnished cotton-twine nets and the tools and equipment needed to erect them. Each component



Figure 5. Gradual side slopes and low silhouette are achieved when drape sets are used to conceal anti-aircraft weapons.



Figure 6. Supported drape net screening self-propelled howitzer.

net is garnished so that when it is assembled into the drape set the desired overall garnishing pattern is obtained.

- (a) There are four standard net drape sets each having adjustable embrasures which permit partial opening,

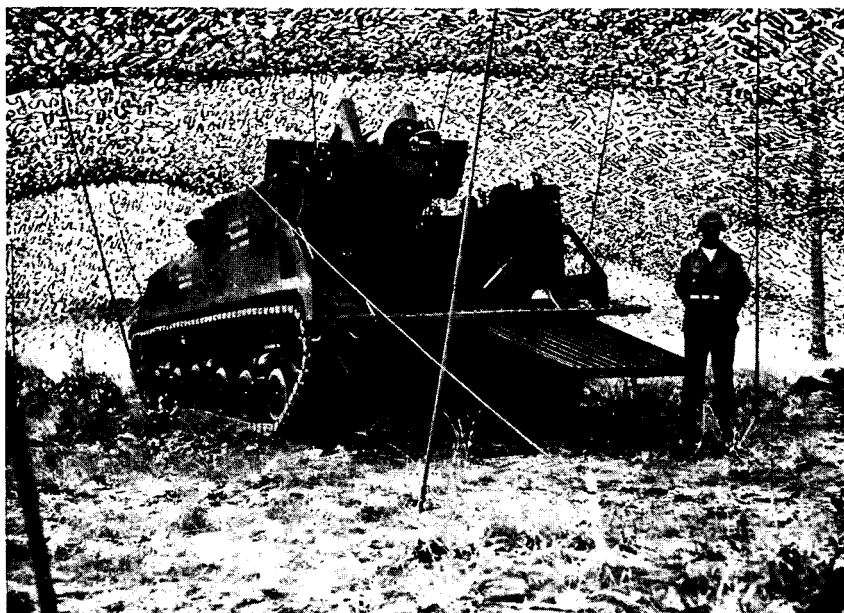
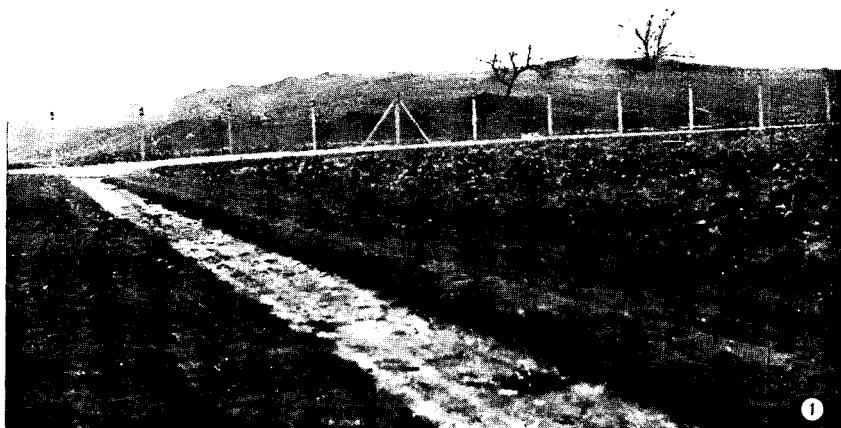


Figure 7. View under camouflage drape net over self-propelled howitzer.

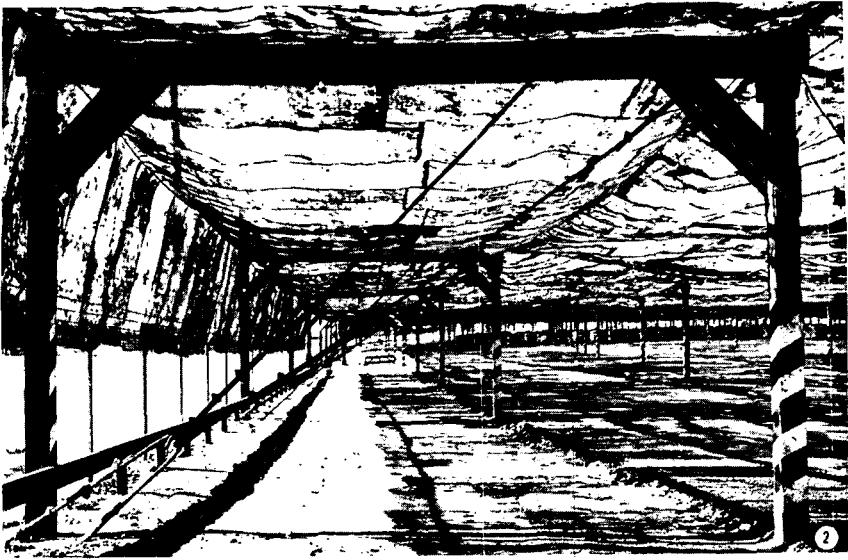


1 Outside view

Figure 8. Screening large areas.

with the sets dropping completely. The latter feature allows for 360° antiaircraft firing.

(b) Drape set No. 1 has four garnished 36-foot x 44-foot



2 Inside view

Figure 8—Continued.

cotton-twine nets. When placed together they form a rectangle 72 feet x 88 feet, having a total area of 6,336 square feet. The area of effective concealment is somewhat less because of garnishing thin-out.

- (c) Drape set No. 2 has four garnished 29-foot x 29-foot cotton-twine nets placed together to give an overall dimension of 58 feet x 58 feet with a total area of 3,364 square feet.
- (d) Drape set No. 3 has four garnished 22-foot x 22-foot cotton-twine nets placed together to give overall dimensions of 44 feet x 44 feet, with a total area of 1,936 square feet.
- (e) Drape set No. 4 although similar in design to the other sets, consists of only 2 garnished 17-foot x 35-foot cotton-twine nets, placed together to give overall dimensions of 34 feet x 35 feet, having a total area of 1,190 square feet.
- (f) Drape sets No. 1 and No. 2 each have two quick-opening embrasures, one bisecting the length, and the other bisecting the width of the set. These embrasures are located along the lines where the four nets are joined and permit the nets to be dropped so that they will not interfere with elevating the barrel of the weapon and will not be damaged by muzzle blast.

Drape set no. 3 has one quick opening embrasure from front to rear of the set. Front nets are attached to rear nets by lacing loops which do not form a quick-opening embrasure. Drape set No. 4 has a quick-opening embrasure extending the entire length of the long axis where the two nets are joined.

- (g) The loop-rings used to join nets together have a $\frac{1}{2}$ -inch inside diameter and are crimped into the inner edges of the nets, spaced at every fourth mesh (fig. 10). The pins are made of 15-gage spring steel and are attached at $10\frac{1}{2}$ -inch intervals to the embrasure release cable (fig. 10). The release cables for all drape sets are identical in design and differ only in cable length and number of pins required. The release cables are made of $\frac{1}{8}$ -inch iron sashcord and each has a $1\frac{1}{2}$ -inch spring snap attached to one end, permitting two or more cables to be connected. The cables also have a blue plastic marker at their midpoint to facilitate the joining of the nets. The inner edges of the units are brought together to close an embrasure and the double loop-rings of one edge are meshed with the double loop-rings of the other edge (fig. 11). Then the spring pins of the release cable are compressed and inserted through the four loops.
- (h) The garnished nets are held rigidly in place by guy-ropes. Poles of 1-inch steel tubing, with wire caps (fig. 12), are used to support the nets over the weapons to be concealed. Each pole section is 4 feet 3 inches long and has a $1\frac{1}{8}$ -inch inside diameter pipe welded onto one end of it. The poles are designed to be extended in segments of 4 feet by inserting one pole section. The pole sections are held together by spring locks. To prevent damage to the nets and to avoid a jagged or telltale outline caused by the appearance of sharp points at intervals along the nets, lightweight wire caps are used. These caps, 20 inches in diameter are held in place on the poles by 3 wire prongs, which are designed to release themselves when the pole falls to the ground and thus prevent damage to the caps.
- (i) With weapons having 360° traverse, such as antiaircraft guns, support poles cannot be used in the emplacement pit or on the weapon, for in a deep emplacement the walls prevent the poles from falling completely and thus halt the outward travel of the net. To insure that the nets will clear the antiaircraft

weapon and the emplacement pit on their outward movement, support poles of sufficient length to hold the nets at least 3 feet above the highest point of the weapon are staggered around the parapet. In addition, the 4 end guys adjacent to the embrasure are anchored at angles diverging from the embrasure centerline. This gives the nets enough slack to be carried clear of the pit and also snap to the movement when the embrasure is released.

- (j) With anti-aircraft guns and other weapons which must be brought into action immediately, the length of time required in opening the embrasure and disposing of drape set parts that might interfere with movements of the weapon is extremely critical. The pins of the release cable must be placed with their points toward the center of the set so that the cable can be pulled from the edges of the set and fall free of the weapon. Also, the proper method of erecting support poles and of preparing the embrasure must be used so the drape will fall completely free of the weapon and the emplacement pit, permitting unobstructed movement of the crew and a 360° field of fire for the weapon.
- (k) Gun crews can erect any one of the 4 drape sets in an average time of 18 minutes and dismantle and pack it in approximately 10 minutes. The embrasures can be opened in approximately 2 seconds. Drape sets can be erected easily at night under blackout conditions because the nets of each set are interchangeable as to position within the set, and the support poles and caps are interchangeable and have no set position. A gun crew can erect them under blackout conditions in an average time of 30 minutes and dismantle them in approximately 15 minutes. Most of the components of the four drape sets are interchangeable.

c. *Wire Netting.* Wire netting (netting, camouflage, wire, steel) is issued in rolls of 6 feet wide in various lengths and is available either ungarnished, or garnished with steel wool, feathers, glass fiber, or fabric (table XXVIII). It is rust- and fire-resistant and has less tendency to sag or deteriorate in use than do the cottontwine nets. Because it is bulky and stiff, wire netting is not intended for numerous erections and dismantlings in the manner twine nets are employed by mobile units. In moulded or sloped screens, however, it will hold a shape indefinitely, and it is the best covering material for such use.

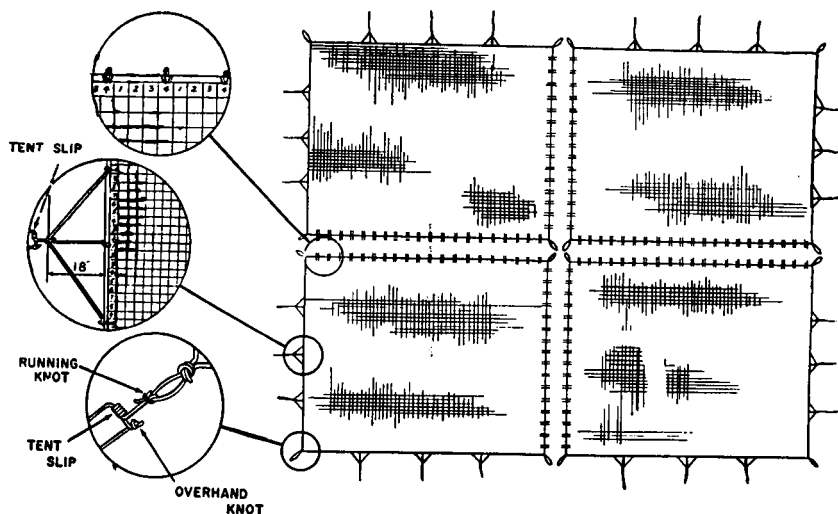


Figure 9. Layout of nets showing guyrope placement and embrasure rings.

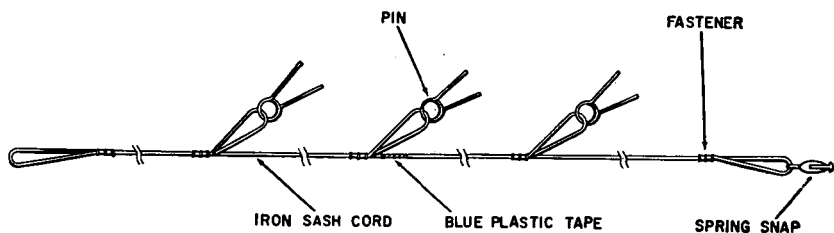


Figure 10. Embrasure release cable.

9. Maintenance and Weaving of Twine Nets

a. *General.* Successful maintenance requires frequent inspection of installations, active control measures for camouflage discipline, and if possible, aerial observation and photographs of the occupied area to correct errors in camouflage.

- (1) Nets require periodic structural maintenance. Abnormally high winds or snow loads weaken the supporting systems, which should be checked frequently during and after such strain. During times of unusual strain, additional temporary supports may prevent collapse or serious damage. Also during snow, ice, or wind storms, it may be necessary to shake the nets free of snow and ice, drop the poles, or even remove the nets for the duration of the storm. In damp or rainy weather, guyropes are slackened to allow for contraction of the nets.

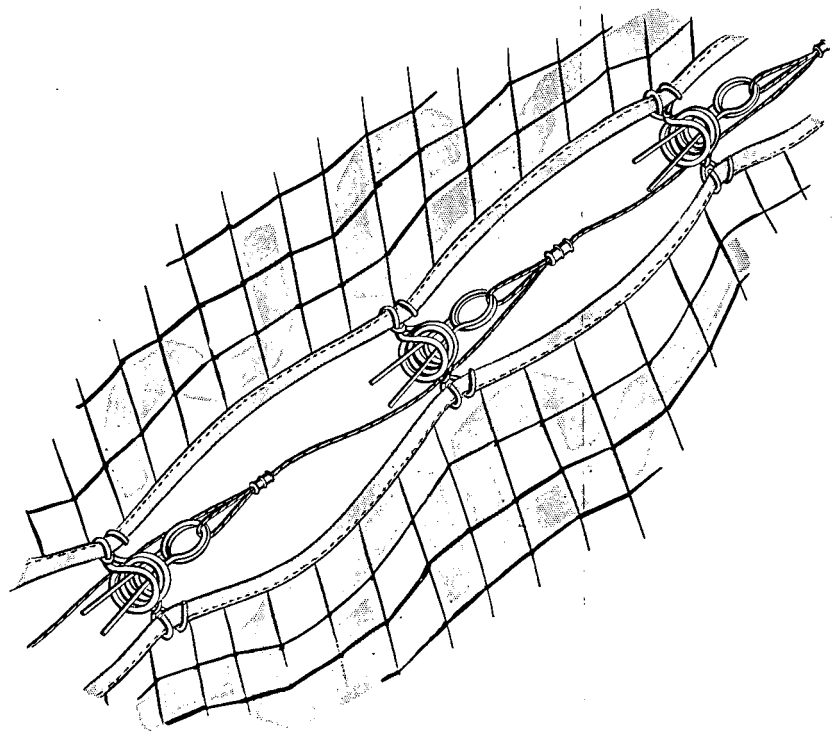


Figure 11. Detail of embrasure connection showing position of ring loops and release cable pins.

- (2) Folded nets generate heat; to prevent their catching fire, store them in a well-ventilated place. To prevent nets from becoming weakened by mildew or dry rot, they are opened and exposed as often as required by storage conditions.
- (3) Nets of recent issue are not fireproof, although they have been treated to become fire retardant. Since most garnishing smolders when exposed to flame, care should be taken to keep nets clear of open fires or exhausts.
- (4) Inspect nets frequently for torn or wrinkled garnishing and for tears in the net itself. Replace unserviceable garnishing and mend tears as soon as discovered to prevent the tears from spreading. No. 24, commercial, medium-laid seine twine, or its equivalent, should be used for mending. Mending of repairs is explained in paragraph 9c.

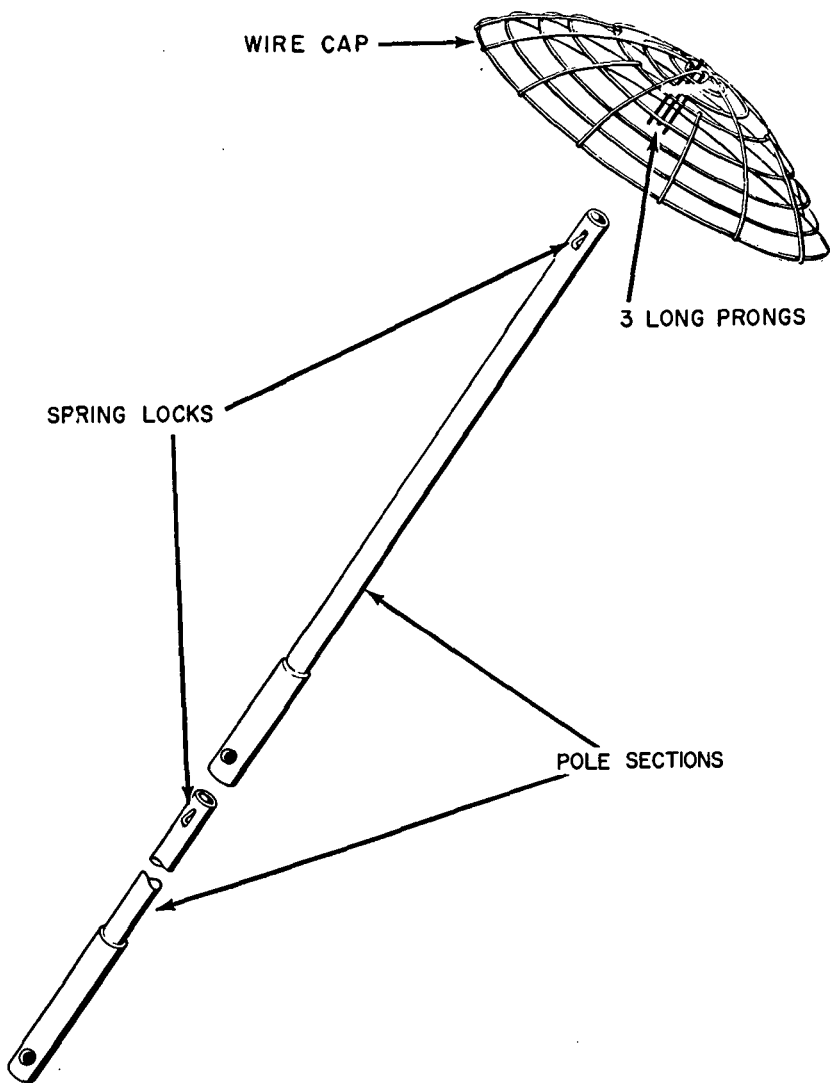


Figure 12. Support pole section and wire caps.

b. Materials Needed for Repairing Twine Nets.

- (1) *No. 18 (18-thread) medium-laid seine twine.* One pound of twine contains approximately 1,000 linear feet. This is a class IV issue item.
- (2) *Pocket knife.*
- (3) *Netting needle.* This is available commercially, or can be a field expedient made of thin hard wood 6½ to 8 inches long, ⅝ to ⅞ inch thick (1, fig. 13). As a field expedient cut out the central spine just long enough so that it must be pushed to one side or the other to permit

the loops of twine to pass over its point. This prevents the needle from unwinding when dropped but permits the user to unwind one loop at a time by a slight pull towards the point of the needle. A good needle also may be made by soldering together two 16-inch lengths of 10-gage wire after they have been bent to shape (2, fig. 13). One piece forms the exterior and is bent in a simple elongated U shape. The second piece forms the body and spine. It is bent in an elongated, rectangular shape with the spine extending from the center of one end, and the joint is soldered. The long sides of the body are soldered to the exterior wire. Be sure that the sides of the U-wire extend beyond the body section.

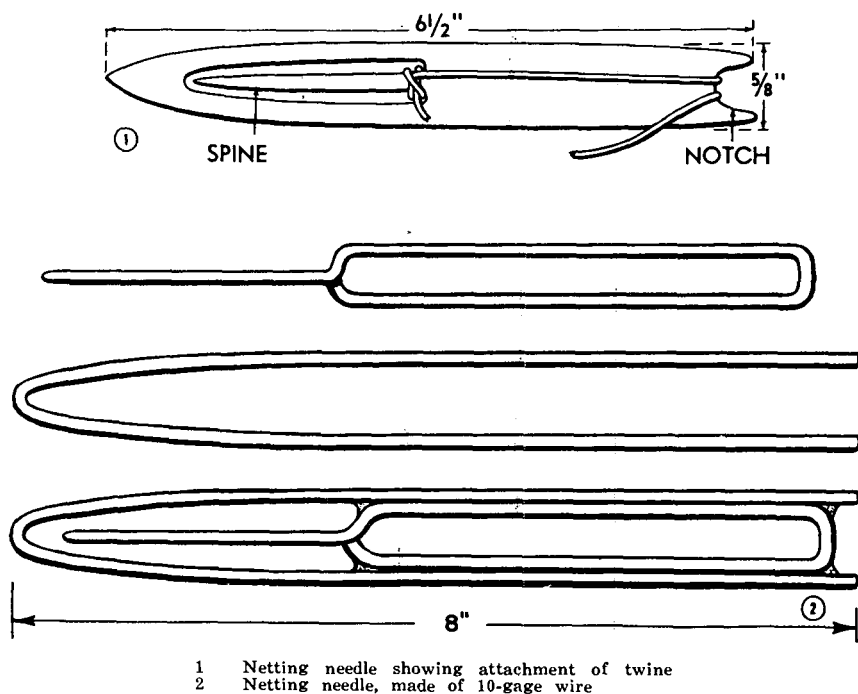


Figure 13. Types of netting needles.

c. Repairing Tears.

- (1) The first step in mending a torn or cut net is to trim away the edge of the tear so that weaving is not interrupted by frequent cutting.
- (2) The first requirement is that mending must start and finish at a knot joining three strands or from a tag end leading from such a knot. This is necessary because

only one end of mending twine is attached at a knot, and unless the knot is already composed of three unbroken strands of the original net, the repair will not have the required four strands radiating from each knot.

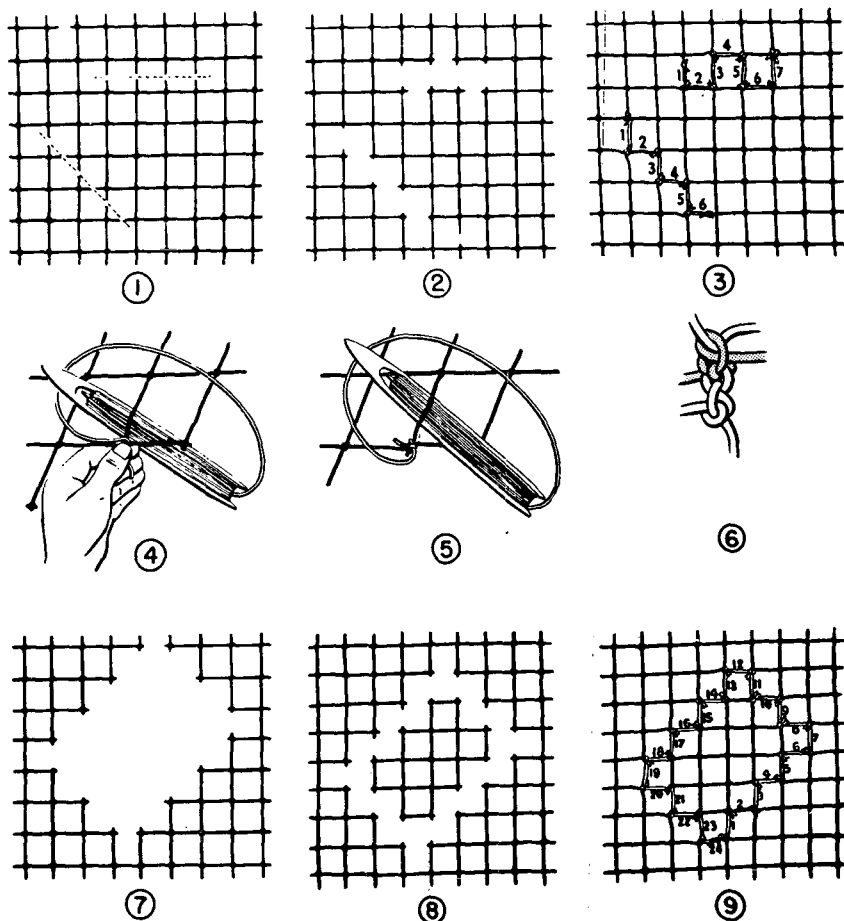
- (3) The second requirement is that, excluding starting and finishing knot, knots around the edges of the tear have only two unbroken strands of the original net.
- (4) In trimming the tear, unnecessary tag ends are cut off first, then enough other strands are cut out to satisfy the above requirements.
- (5) Different typical tears before trimming, the same tears after trimming, and the sequence in which the tears are woven are shown in (1, 2, and 3), figure 14.

d. Weaving Tears.

- (1) The end of the twine is tied on as shown in (5), figure 14 when the mend starts at a knot where three strands join. Note that the end of the twine is placed between two of the strands, and the second hitch is made around the middle strand only. The second hitch is made this way to bind the end of the twine more securely without excessively distorting the shape of the mesh.
- (2) If the mending starts or finishes at a tag end, the twine is tied to the tag end with a square knot.
- (3) The sequence of weaving depends upon the shape and position of the tear with respect to the weave of the net and must be determined for each job. Figure 14 shows the sequence for the tears illustrated. The most convenient method for finding the proper sequence of weaving the tear is to spread the net out flat so that the meshes are square; then thread the twine through the meshes until the proper sequence is found by trial. The twine then may be cut and left in the net to guide the weaving. The guiding twine is removed after the repair is finished. With practice, one will become sufficiently expert to dispense with a guiding twine.
- (4) In adjusting a loop, care must be taken to note whether the loop forms one or two sides of a mesh and to adjust the size accordingly.
- (5) Some complicated tears cannot be rewoven in a continuous sequence without cutting out an excessive amount of net. In such cases, it is better to trim less extensively and weave several sequences, beginning and ending at 3-strand knots, as described above.

e. Patching a Large Hole.

- (1) To mend a net containing a large hole insert a patch



- 1 A section of torn net—dotted line indicates tears
- 2 The two tears properly trimmed
- 3 Repairing tears, starting at 1 and tying at 6 and 7
- 4 First hitch
- 5 Second hitch
- 6 Completed hitch
- 7 Rectangular hole cut at 45° angle to the mesh
- 8 Patch placed in position
- 9 Patch joined to net by weaving from 1 to 24

Figure 14. Repairing and patching nets.

cut from a scrap net or weave a piece of net and insert it in the hole. Figure 14 indicates the proper procedure for weaving.

- (2) The first step in patching is to lay the net out flat and pull the meshes square. Then enlarge the hole to a roughly rectangular shape—45° to the mesh—surrounded by knots joining two strands (7, fig. 14). Unlike the procedure in mending tears, a 3-strand knot is

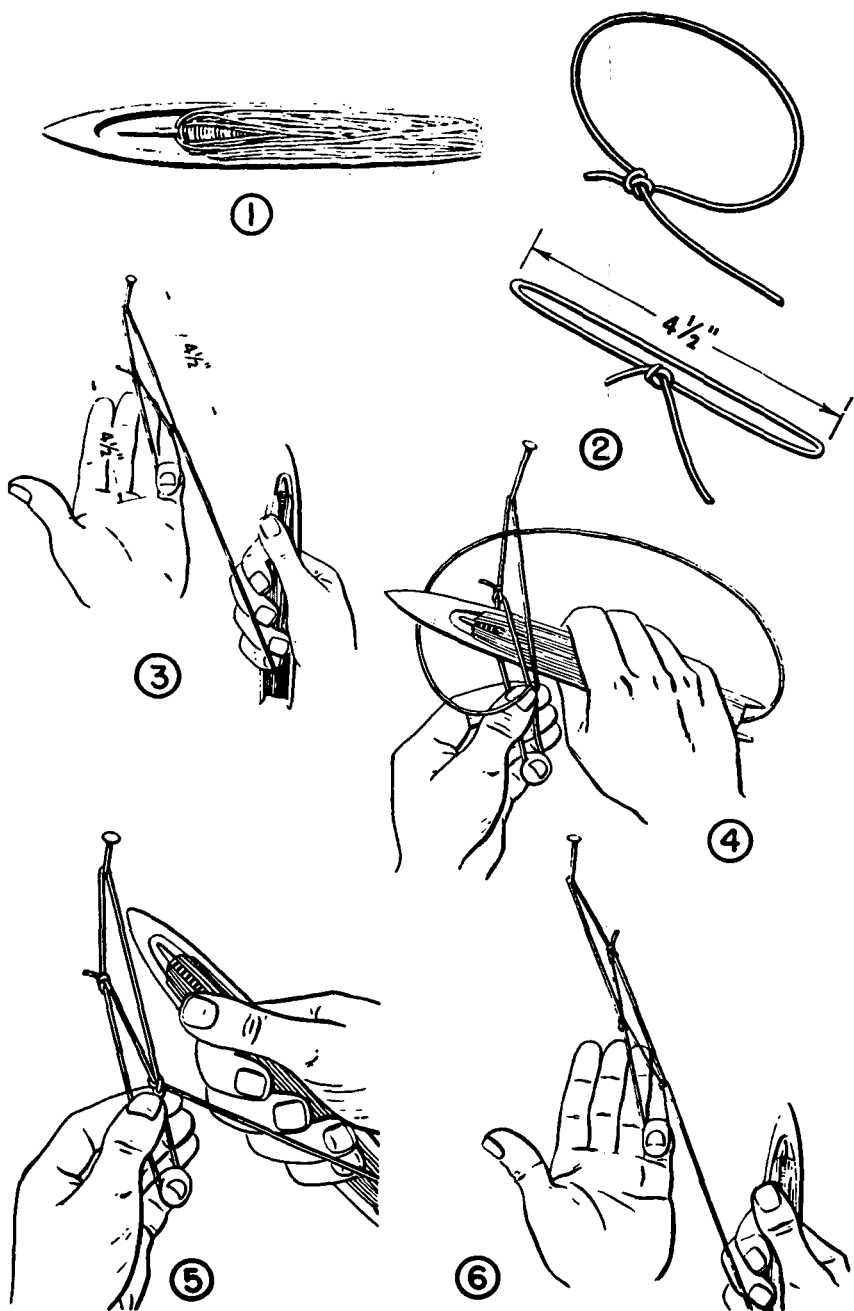
not used for starting or finishing the insertion of a patch. This is because patch weaving starts and finishes at the same knot rather than at different knots as in mending a tear.

- (3) A rectangular patch is now cut or woven with one less 2-strand knot on each of the sides than is found on the corresponding side of the hole (8, fig. 14).
- (4) The patch is inserted in the net by weaving continuously around it, as shown in 9, figure 14.

f. Use of Fish Netting. Ordinary fish netting may be used for camouflage purposes but before garnishing, it must be checked for its characteristic diagonal weave and garnish materials inserted along the diagonal.

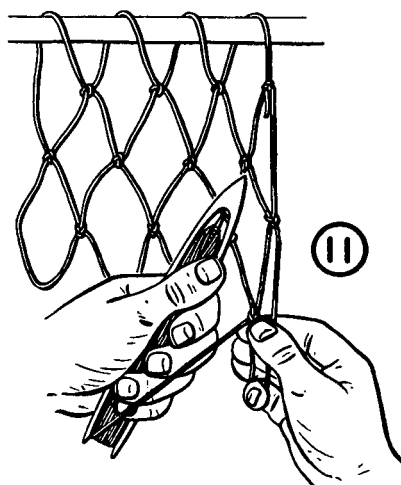
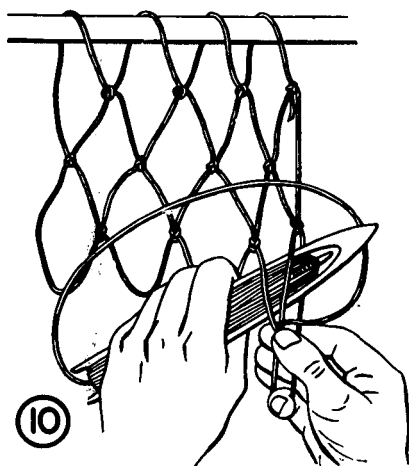
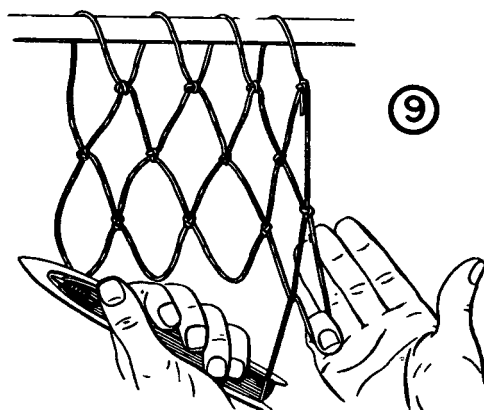
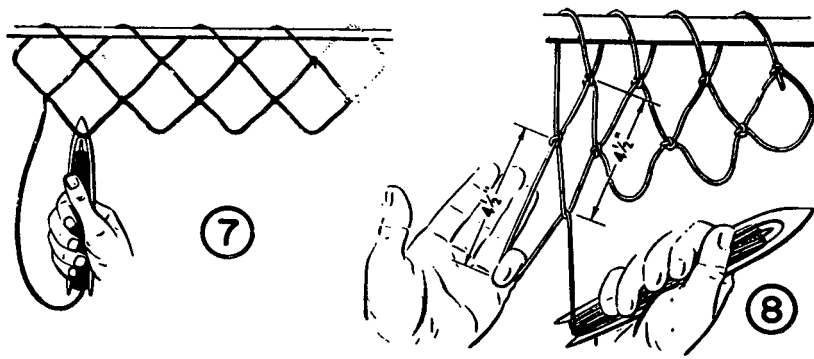
g. Weaving Nets, Field Expedient Method (fig. 15). If necessary, large-mesh nets can be woven in the field. The materials needed are the same as listed in above paragraph 9b. Civilians and indigenous labor can be trained in net weaving and considerable speed may be attained with practice. A method of weaving is described below and illustrated in figure 15.

- (1) To fill the needle, tie end of twine around base of central spine with a clove hitch, leading it down one side to notch and up other side to tip of spine (1). Bend spine enough to permit twine to loop over it and continue to wind in the same way. Continue until twine is approximately $\frac{1}{4}$ inch from end of spine. Leave a free end of about 24 inches of twine.
- (2) Make a loop by tying a bowline in free end of twine (2). Length of loop when stretched so that sides come together should be same as distance between diagonally opposite knots of a mesh stretched so that the sides come together. This dimension is called the "mesh". A standard camouflage net has a $4\frac{1}{2}$ -inch mesh, which means each small square is $2\frac{1}{4}$ inches on a side.
- (3) The next step is to weave a chain of meshes equal to length of net desired (3). To make a chain, suspend loop just formed from a conveniently placed nail. Turn loop so that knot is in middle of left hand side. Pass needle up through loop with right hand, regrasp needle with right hand and pull it down towards right hip. Hook left little finger in new loop from behind so loops may be grasped by left hand. Adjust new loop to same size as first one by pulling with needle or with finger. Loops and twine should be stretched firmly toward weaver at this stage.
- (4) When size of loop is adjusted, grasp twine where it passes through first loop with left thumb and fore-



- 1 Filling the needle.
- 2 Making a loop by tying a bowline in free end of twine.
- 3 Weaving a chain of meshes equal to length of net desired.
- 4 Grasping twine where it passes through first loop with left thumb and forefinger.
- 5 Regrasping point of needle with right hand.
- 6 Removing first loop from nail, turning it over and replacing it.

Figure 15. Weaving large-mesh twine net.



- 7 Body of net made by weaving onto side of the chain.
- 8 The twine leads off from lower left-hand knot.
- 9 Changing needle to left hand, passing point up and to front through last mesh woven.
Hook little finger of right hand in loop.
- 10 Throwing a loop of twine up to right front, passing needle from left to right behind mesh.
- 11 Continuation of weaving back and forth.

Figure 15—Continued.

finger (4). Note that thumb is behind twine leading to needle and that thumbnail grips bottom of old loop. Now throw a loop of twine up to left front with running end leading from top of loop. Pass point of needle behind two sides of first loop and in front of twine leading down from original bowline to left little finger and through loop just thrown up to left front. Appearance should now be as shown (4).

- (5) Regrasp point of needle with right hand and pull knot tight by pulling the needle down towards right hip, at the same time keeping a firm hold with left thumb and forefinger and with left little finger (5). Mesh is now completed and should appear as shown.

Caution: Do not release hold with thumb and forefinger of left hand until knot has been tightened.

- (6) Remove first loop from nail, turn it over and replace it so that twine again leads from middle of left hand side of loop (6). Weave another mesh in same manner as first one; turn chain over and continue until number of meshes desired for one side of net has been made. After first few meshes are woven it no longer is necessary to remove end loop from nail and turn the whole chain over. The chain can be twisted until twine leads off from left side. After each mesh is woven, twist chain back to weave next mesh. If net is to be used to patch another net, the exact number of meshes required should be counted. Otherwise, it is sufficiently close to allow 17 to 17½ inches of chain per foot-length of net. This is the standard used in making issue camouflage nets and should give a net which stretches tightly when pulled out.
- (7) Body of net is now made by weaving onto side of the chain (7). The chain is removed from the nail and spread out as shown. The needle (7) indicates first mesh that will be used in weaving back and forth across the net. The edge meshes may be strung on a rod. Have the net hang so that loops are free to slide together because it is then much easier to judge correct size of loop than when the net is spread out. In either case, meshes will begin to close up after five or six rows have been woven. The hanging bar is thrust through as shown so that all twine crosses the front of the bar in the same direction. This makes the net hang evenly.
- (8) With the chain hung up as described above, the twine should lead off from lower left hand knot (8). Pass needle up through mesh to right of knot. Hook left

little finger in loop. Adjust length of loop so that distance from knot directly above little finger to bottom of loop equals total length of mesh. Complete tie just as was done in making chain. Pick up next loop to right, tie into it, and proceed across to right hand edge of net. If chain contains an odd total number of meshes, the last mesh on right is strung on rod (dotted lines in 7, fig. 15) and must be skipped in weaving body of net.

- (9) Change needle to left hand, pass point up and to front through last mesh woven, hook little finger of right hand in loop, and adjust to length (9).
- (10) Throw a loop of twine up to right front, then pass needle from left to right behind mesh being tied into, in front of loop hooked on finger, and through loop thrown up to right (10). Pull knot tight and continue weaving from right to left in same manner until left hand edge of net is reached. Change needle back to right hand and work back from left to right as in first row of body.
- (11) Continue weaving back and forth until desired length is reached (11). The length is determined in the same manner as length of chain, by counting mesh if for a patch or by measurement if for a complete net. Ties must be made as described so that twine will lead directly from one knot to next without crossing twine coming into knot. If trouble is experienced with twine crossing itself when ties are made as described, it indicates that the knots are not being pulled tightly into proper shape. Probably the little finger is not holding loop tightly enough as the knot is pulled tight.

10. Expedient Screening Materials

a. General Several expedient screening materials have been listed below; there are many more that can be found or improvised locally.

b. Snow Fencing. This can be used as overhead screening. When employed by highway departments this flexible fencing is erected vertically. For camouflage, the fencing normally is supported horizontally or at an angle to the ground (fig. 16). It is effective only against high-altitude observation. Snow fencing is obtainable from manufacturers of fencing in rolls 4 feet wide and 100 feet long, weighing 250 to 300 pounds per roll. It is made of wooden slats, each $\frac{1}{2}$ inch by $1\frac{1}{2}$ inches by 4 feet, which are interwoven, small gaps being left between slats, by five double strands of $12\frac{1}{2}$ gage wire. The fencing comes stained red or unstained and must be painted or textured, as by the application

of sand to the paint when wet. Because of its weight, adequate support must be provided.

c. *Truck Tarpaulins.* Tarpaulins occasionally are useful where an opaque and waterproof fabric is needed. For example, they have been used over a supporting framework to cover dug-in positions, as shown in figure 17. Camouflage over the tarpaulin must be added.



Figure 16. Snow fencing covering field artillery piece.

d. *Fine-mesh Screening.* This is placed over observation and firing apertures in various camouflaged positions, such as those simulating rocks, to form removable screens which break up the shadow of the opening. Salvaged wire fly screening, dyed mosquito netting, or similar closely-woven mesh net is used for this purpose. Galvanized 16-gage wire screening when painted white is excellent in concealing small installations in snow conditions.

e. *Field-expedient Mat Screens.* These are used for making imitation native thatched houses, imitation thatched roofing, and false hedges and are woven on an improvised mat loom. They are made of local materials, such as brush, corn stalks, palm fronds, sugar cane, reeds, or thatch.

- (1) *Improvisation of mat loom for weaving screens.* Posts are set firmly in ground at 2-foot intervals and guyed to stakes, as shown in 1, figure 18. Wider mats require additional pairs of posts to accommodate extra wires.
- (2) *Method of weaving.* Fasten strands of 16-gage wire to nails in top of each of three posts, A; stretch to a sapling slightly longer than the width of the desired screen,

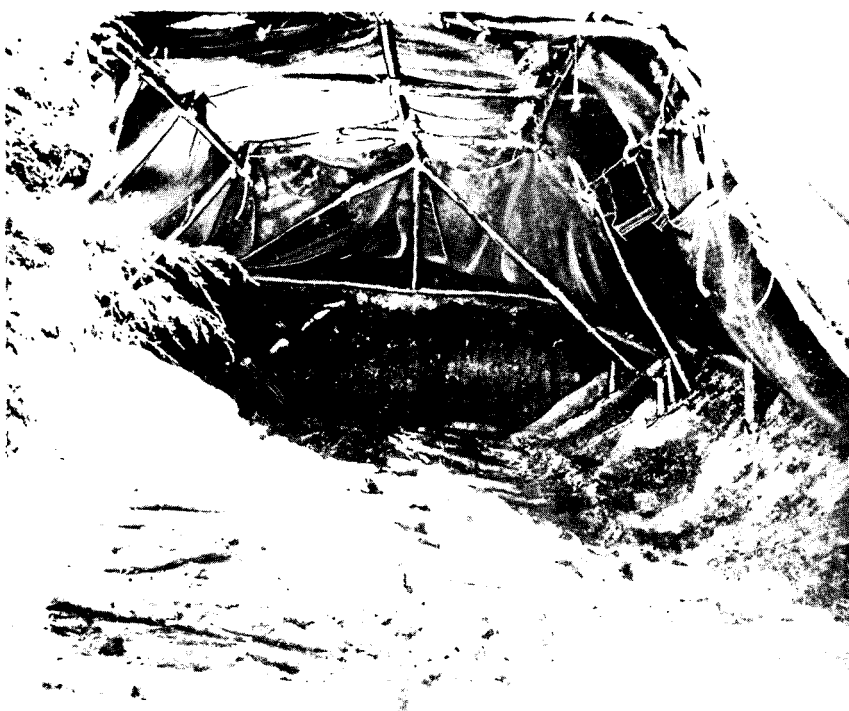
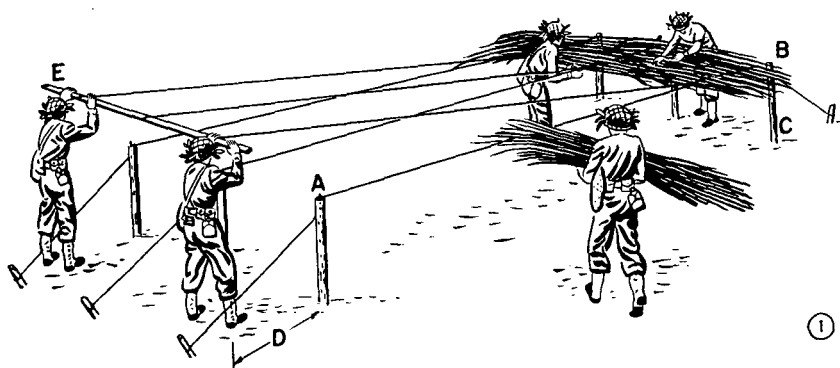


Figure 17. Truck tarpaulin covering dug-in position.

B; pass each wire around sapling, which is then nailed to top of posts, C, (2, fig. 18). Leave nail heads exposed for easy removal. Continue wires back to D, a point 3 feet beyond posts, A. The wires then are fastened to another sapling, E, as reeds or other materials are inserted in about 6-inch sections. Tighten up on the wires every other section. When mat screen is completed, cut wires at A and B and fasten sapling, E, to edge of screen by the loose ends of the cut wires.



¹ Improvised mat loom.
Figure 18. Weaving field-expedient mats.

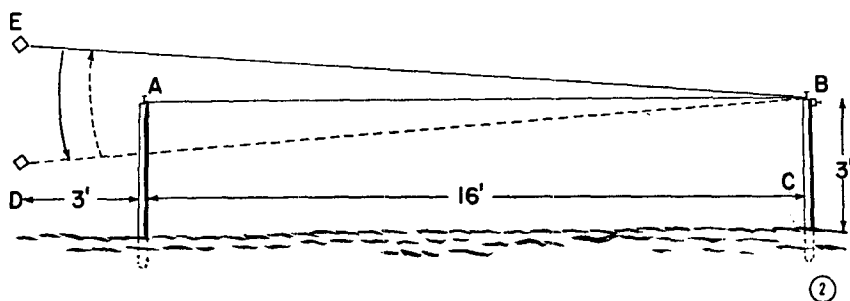


Figure 18—Continued.

11. Natural Materials Used as Screens

a. Types of Materials. Many types of straw, hay, brush and foliage may be used directly to cover supplies, wire communications, and equipment (figs. 19, 20, and 21). Whenever necessary, overhead screens, may be created by attaching natural materials to a frame work or by planting and transplanting tall-growing or wide-spreading vegetation.



Figure 19. Ammunition in open, being covered with straw.



Figure 20. Tank sited near thatched-roofed building and camouflaged with natural straw.

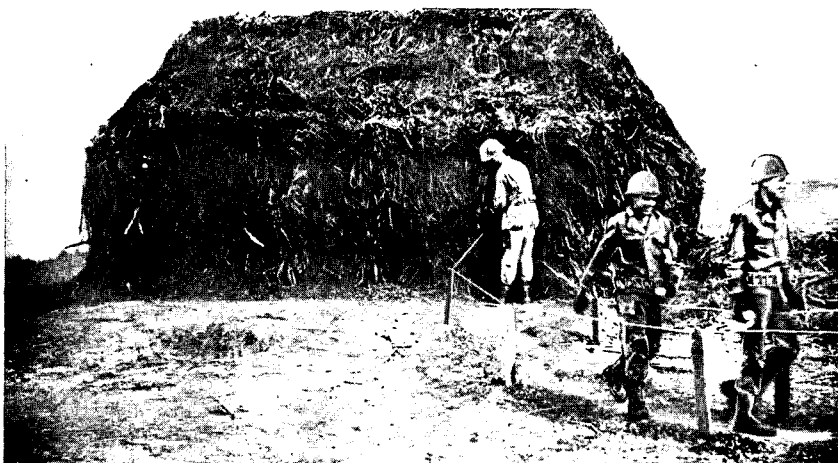
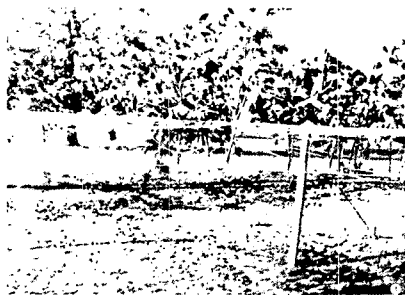


Figure 21. Building covered with hay to simulate haystack.

b. Cut Foliage. This is excellent for overhead screening. Care must be taken to place green vegetation in a natural position because the underside of leaves photograph at a lighter tone. Lengths of wire netting are placed side by side with overlapping and without fastening adjacent edges. By parting the unfastened

edges, men working in the opened spaces between the lengths stick branches in the wire netting so that the butt ends project downward 8 to 12 inches. The butt ends are then wired to hold the branches upright (1 and 2, fig. 22). For most useful types of foliage, see tables XXXII and XXXIII, appendix III; for foliage preservative methods, see paragraph 42.



1 Cut foliage inserted in low flat top with butts anchored.



2 Cut foliage inserted through two layers of wire netting.

Figure 22. Cut foliage used for screening.

c. *Cut and Tufted Bunches of Straw or Grass.* These, wired or tied together and with the ends dipped in tar, afford a covering material of good color and texture. They may be forced onto nails, projecting from strips of wood, inserted into the meshes of wire netting, or suspended by wires. Loose hay or straw may be thatched over a framework of bent saplings covered with wire netting to simulate haystacks or native huts (fig. 21). One method of fastening the material is to cover it with another layer of ungarnished wire netting. The chief disadvantage of dry grasses and straw is their extreme inflammability.

d. *Growing Materials.*

- (1) Vines and tubers, such as sweet potatoes, yams, and Chinese potatoes, may be placed in water-filled tin cans secured to wire netting. Cans are painted olive drab or smeared with mud. A few leaves or a piece of burlap floating on the water in the cans kills reflections. Train vines to grow over the netting (fig. 23), or utilize standing vines (fig. 24).



Figure 23. Overhead cover from vines growing in tin cans fastened to a flattop.



Figure 24. Use of standing vines to screen field emplacement.

- (2) Wetted moss, especially Spanish moss, can be grown on netting. It attaches itself to the netting and sustains life from the air. Green when damp, it changes to gray-green when dry.

e. Debris Used as Cover. Debris, supported by nets, netting or light structures, provides a covering material of excellent camouflage value. Any litter, whether of dead vegetation, paper, lumber, or metal, can be so placed as to provide effective concealment from observation (fig. 25).

12. Supporting and Structural Material

a. General. Structural materials are those required for building a framework for the attachment, suspension, or support of camouflage materials. They include posts, stakes, wire, wire rope cable, rope, twine, and steel clips and brackets. These are obtained from engineer depots and commercial sources or are improvised from field-expedient materials. It should be noted that, in many cases, screening and other camouflage materials need no support but may be placed directly on and be supported by the object to be camouflaged.

b. Wire and Cable.

- (1) *General.* In some theaters of operations issue wire is extremely scarce; in such instances every effort should be made to limit its use to structures of importance. The steel binding tape used on boxes may be salvaged and

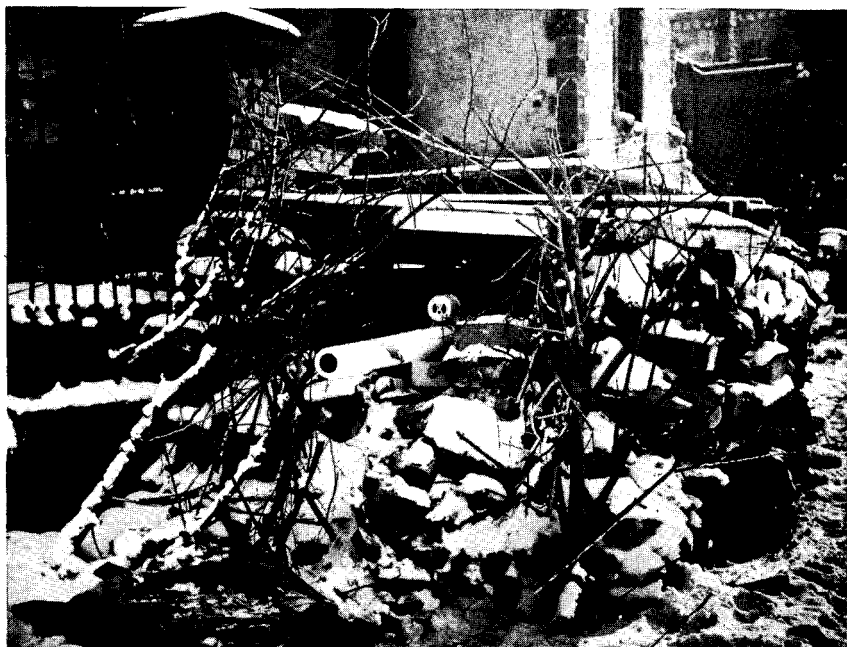


Figure 25. Gun emplacement under cover of debris.

used where short lengths are practical. For some uses, locally procurable rope also can be substituted for wire. Barbed wire can be used in the construction of flat-tops in the absence of a more suitable plain wire. Wire is issued normally in 16-gage and 10-gage sizes (tables XXIX and XXX).

- (2) *Wire rope cables.* Wire rope cables usually are required where spans in excess of 80 feet are contemplated. To prevent the weight of the cable from causing excessive sag, one is used which has the smallest practicable diameter. Turnbuckles are used to take up slack. Clamps are used to fasten auxiliary wire cables. In emergencies, small lengths of cable may be secured from the motor transportation sections of motorized units. The most useful sizes of cable for normal camouflage construction have been found to be $\frac{1}{4}$ inch and $\frac{3}{8}$ inch. Numerous types of wire ropes are class IV material; the following items, however, are included in organic camouflage equipment sets:
 - (a) Rope wire, steel, tiller, galvanized, fiber core; 6 x 7 stranding $\frac{1}{4}$ inch.
 - (b) Wire, cast steel, galvanized, 6 x 19 stranding $\frac{3}{8}$ inch.

(a) and (b) are supplementary equipment in Set No. 3 (Camouflage Battalion, Army): (a) is in Set No. 2 (Camouflage Company).

c. *Fibrous Supporting Materials.* Rope and twine can be used in camouflage construction, especially in temporary installations when wire is not available. The disadvantages of fibrous materials is that they stretch and shrink with changes of humidity. This makes their use less desirable because they require greater maintenance. Many types and sizes of ropes and twine are class II and IV issues, but locally fabricated rope may be procurable in theaters where no issue ropes are stocked. Sisal rope is obtainable locally in some areas and may be used for guying and the support of nets. The sizes in which it may be found vary between $\frac{1}{8}$ inch and $1\frac{1}{4}$ inches. The most useful size for camouflage purposes is $\frac{3}{8}$ inch, which has an average breaking strength of approximately 612 pounds.

d. *Field-Expedient Materials.*

(1) *Greenhide rope.* In some cattle growing areas, rope is made frequently from untanned, stretched hides as follows:

(a) Scrape most of the hair from the hide. Cut it into a strip $\frac{3}{4}$ inch to 1 inch wide by starting from the center of the hide and cutting spirally outwards like a flat clock spring. Then soak the strips overnight in water to soften.

(b) To make a 3-strand twisted rope:

1. Take 3 strips, each about twice the length of the required rope. Tie a movable weight, such as a gasoline can partly filled with stones, to one end of each strip to keep it taut.
2. Make a small slit in each of the free ends and tie them to a winding handle. This may be a metal handle fixed through a tree or post, or even a cart or motor wheels with a hook on the axle.
3. Twist the strips clockwise, and the rope is formed.
4. Allow it to dry for a few days.
5. If time permits, it is preferable to twist each strand separately, counterclockwise, before all 3 are twisted together clockwise. A much better rope is produced in this way.
6. The 2 ends of the finished rope should be seized or whipped.

(2) *Bamboo rope.* Another expedient for rope is to split green bamboo of the hollow type into small sections and split each section several more times. Plait 3 of these

long thin strips together. To complete the rope, take 4 of the resultant 3-ply ropes and plait together.

- (3) *Creepers.* Similarly, creeping plants may be woven into ropes.

e. Posts, Stakes, and Other Structural Materials. Normally in the field, posts and stakes are procured locally. They may be cut on the site from existing small trees or salvaged from abandoned civilian structures. Bamboo, when available in the area, can be used for light construction work. Barbed wire pickets and round steel stakes can be used in place of wooden stakes which, in some types of ground are more efficient.

f. Steel Clips and Brackets. As an example of the supporting devices that may be employed to aid in concealment, we can look at two which have been developed to aid in the camouflage of armored vehicles; the camouflage bracket and the triple-spring clip. Issue items, they are intended to provide holders on tanks and other vehicles for the attachment of natural garnishing on the body or hull and on the gun barrels.

- (1) *Bracket, camouflage, armored vehicle for natural garnishing.* Employment of the bracket, with natural garnishing, will give greater concealment from both air and ground observation by the enemy, help achieve surprise, and provide a more difficult target. The bracket is made from mild strip steel $\frac{1}{8}$ inch thick, and is shaped like an inverted "U" with long flanges. Its overall dimensions are 5 inches by 2 inches by 1 inch. Each flange has an $1\frac{1}{32}$ -inch hole which will accommodate a $\frac{5}{16}$ -inch bolt. Figure 26 shows a bracket attached to an armored vehicle.

- (a) *Methods of attachment.* Attach brackets to armored vehicles by bolting or by welding. Bolt the brackets to thin exterior parts such as fenders and sand shields, but weld them to heavier parts such as the hull and turret. Bolts should be used wherever possible.

1. *Bolting.* Each bracket is issued with one $\frac{5}{16}$ -inch hexagonal head bolt, $\frac{3}{4}$ of an inch long, together with a nut and lockwasher to bolt the brackets to the thin parts of the vehicle, drill two $1\frac{1}{32}$ -inch holes in the section to which the bracket is to be fitted. To insure correct spacing of the holes, hold each bracket in position and use the holes in the bracket as a guide while the 2 new holes are marked or drilled. After the holes are drilled, secure the bracket in position with the accompanying bolts, nuts, and lockwashers. (Although only 1 bolt as-

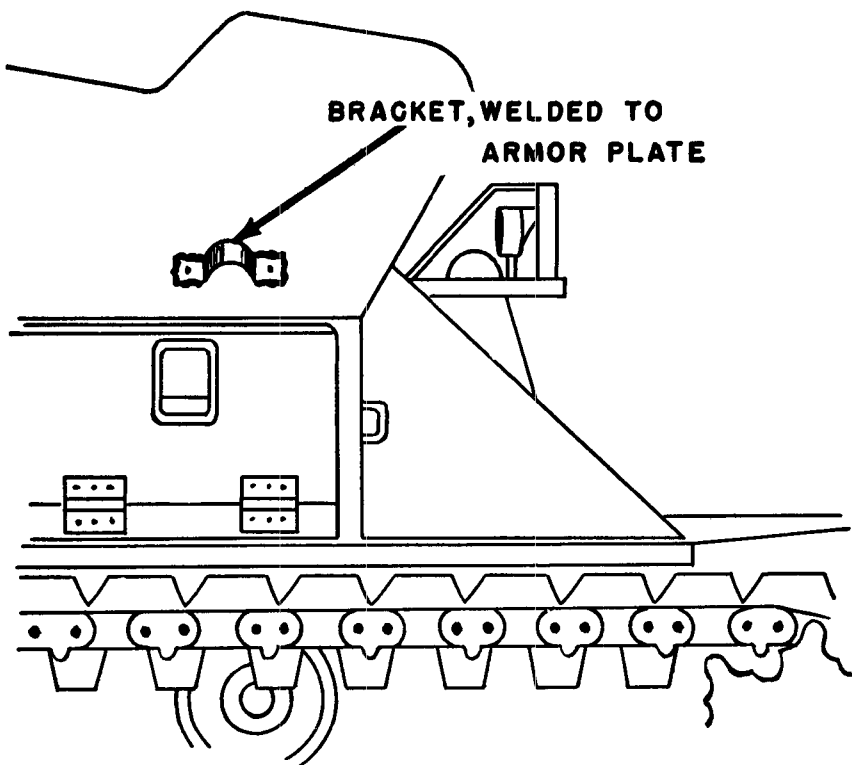


Figure 26. Bracket welded to armored vehicle.

sembly comes with each bracket, some brackets will be welded, thereby permitting that bolt assembly to be used with a bolted bracket.)

2. *Welding.* When brackets cannot be bolted, they must be welded. To prevent damage to the armor, all welding and welding rods must conform with the requirements given in TM 9-2852. The temperature of the armor should be 60° F. or above; if lower the temperature must be brought gradually to 60° F. or above over a fairly large area wherein the weld is to be made.

Warning: Do not weld brackets to gun barrels because such action will damage the gun permanently.

- (b) *Locations on vehicles.* The brackets are issued in bulk lots for attachment in the field at the discretion of the responsible commander. Figure 27 shows suggested locations of brackets on an armored vehicle. However, the presence of extra equipment on the

vehicles or the commander's or crew's experience may make advisable the attachment of the brackets in other locations. When locating the brackets, place them so that a minimum number will hold sufficient natural garnishing to conceal the vehicle from ground and air observation. Where possible, utilize existing projections and loops on the vehicles to hold garnishing. Arrange the garnishing so that it will not hinder the operation of the vehicle or its weapons nor hamper the crew when they are entering, leaving, or servicing the vehicle.

- (c) *Placement of camouflage.* To camouflage the vehicle, use small branches of evergreen or hardy species of broad-leaf foliage. The best branches are 2 to 3 feet long and about $\frac{1}{2}$ inch in diameter at the end which is inserted through the bracket. Wedge together 3 or 4 branches in each bracket as illustrated in figure 28. Do not use large branches in a vertical position because they attract attention when waving about. Small branches bend easily and therefore are less likely to catch on objects and damage the brackets. Remember to place foliage on the turret and top deck to give concealment from the air. Use only sufficient foliage to break up the characteristic outline of the vehicle and produce a textured surface. Inspect the camouflage to assure that there is no interference with observation or with the sighting of the guns. Do not place foliage near the exhaust, where it creates a fire hazard. If correctly applied, the camouflage will be satisfactorily retained throughout rugged cross-country travel, although some of the leaves may be torn off and the lower branches discolored by mud or dust.

(d) *Maintenance.*

1. *Bracket.* The bracket is made of steel which will rust and therefore should be painted immediately after attachment. If the paint wears off, the bracket should be repainted. Should a bracket become bent, straighten it with a hammer or other suitable tool. If broken or badly damaged, it should be replaced.
2. *Camouflage.* Fresh, live foliage, native to the area in which the vehicle is to operate, should be used for each engagement whenever possible. Wilted and broken foliage offers little camouflage. Try to select foliage which is durable and will stay fresh for a

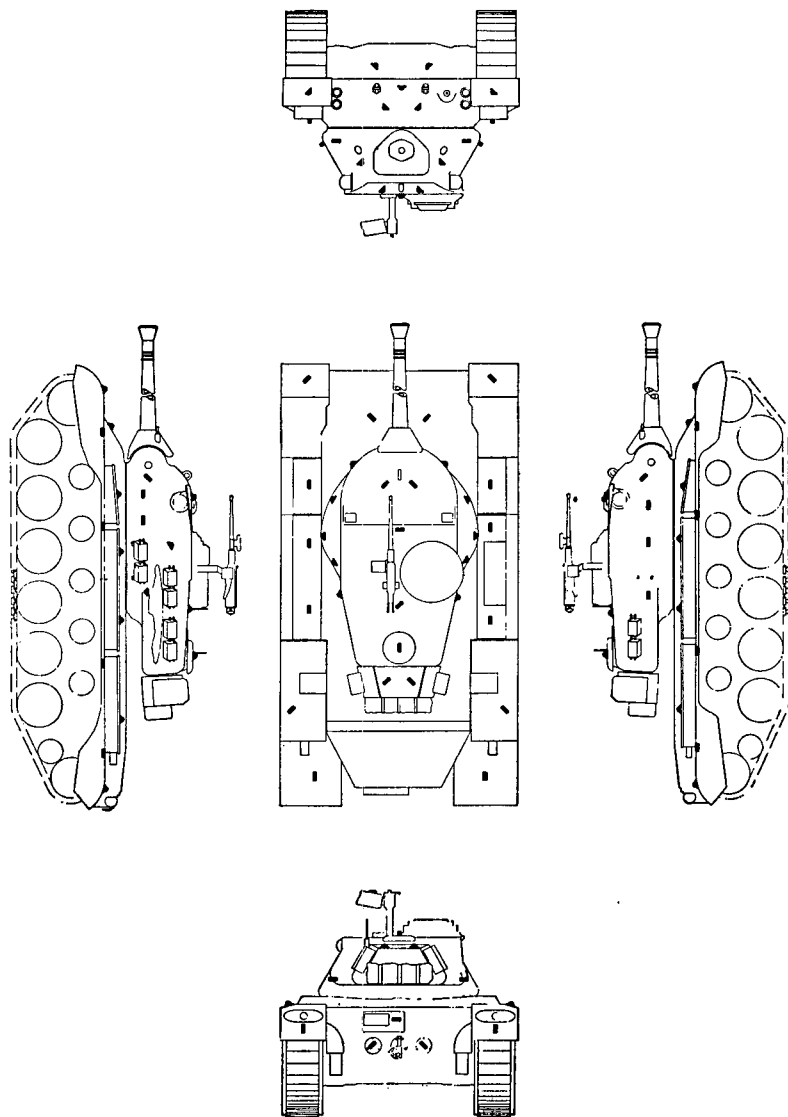


Figure 27. Suggested bracket locations on an armored vehicle.



Figure 28. Bracket with natural garnishing inserted.

long time. The following types have been found most desirable: spruce, pine, cedar, oak, and beech. Avoid types such as willow, aspen, ash, locust, and maple.

Note. The bracket, camouflage, armored vehicle, for natural garnishing is designed for use in conjunction with clip, triple-spring, camouflage, armored vehicle, for gun barrels and is intended to supplement, but not replace, the drape nets normally issued for concealment of vehicles in static locations.

- (2) *Clip, triple-spring, camouflage, armored vehicle, for gun barrels.* The clip, triple-spring, camouflage, armored vehicle is for gun barrels of armored vehicles. Employment of the clip, with natural garnishing, will give greater concealment from both air and ground observation by the enemy, help achieve surprise, and provide a more difficult target. The clip is an assembly of three springs and two hook-and-eye fasteners. Figure 29 shows the clip attached to a gun barrel.
- (a) *Springs.* The springs are closed-coil springs of steel music wire, $\frac{3}{8}$ -inch outside diameter and 16 inches long. A hook is formed in the wire at both ends of the spring.

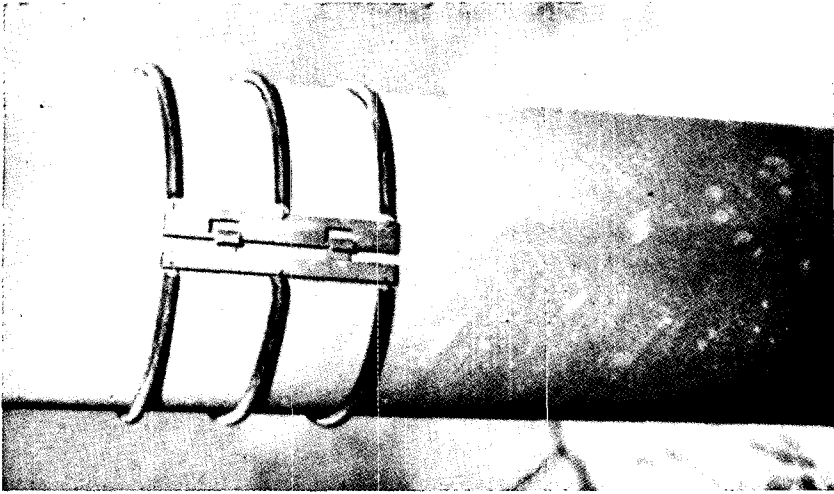


Figure 29. Clip, triple-spring, camouflage, armored vehicle, for gun barrel.

- (b) *Fasteners.* The fasteners are 6-inch-long strips of mild steel. They employ the simple hook-and-eye principle; one fastener has two holes, the other has two hooks. Each fastener has three small holes for attaching the springs.
- (c) *Assembly.* The clip is issued as an assembly of its five component parts (three springs and one hook fastener bar and one eye fastener bar). Hook one end of each spring through one of the three small holes in each fastener. Crimp the hooks of the spring with pliers to prevent the disengaging of the springs from the fasteners. In the resulting assembly, the three springs are parallel and are held $2\frac{3}{4}$ inches apart by the two fasteners. The springs as issued are 16 inches long and are designed for use on 120-mm guns. If the clip is to be used on 90-mm or 76-mm guns, shorten the springs to 14 inches by cutting the springs with pliers and then bending the last coil of the spring into a hook. (Clips can be adapted for any barrel of smaller diameter than the 120-mm gun barrel by shortening the springs proportionately.)
- (d) *Method of attachment.* Fit the clip to the gun barrel by draping it over the barrel with the two fasteners hanging down, one on either side of the barrel with the open side of the hooks away from the barrel. Grasp the fasteners one in each hand, and pull downward, placing the springs under tension. Next fit the

hooks of one fastener into the holes of the other fastener. Then release the tension on the springs. The clip will now fit snugly around the barrel. At least four clips are needed on the 120-mm gun barrel to provide for enough camouflage material to conceal the gun. Three clips are sufficient for the 90-mm or 76-mm gun barrels. Space the clips equally along the length of the barrel.

- (e) *Placement of camouflage.* To camouflage a barrel, use small branches of evergreen or hardy species of broadleaf foliage. The best branches are 2 to 3 feet long and about $\frac{1}{2}$ inch in diameter at the end which is inserted through the clip. Wedge the branches between the springs and the gun barrel as illustrated in figure 30. Lay the branches along the barrel; do not insert them perpendicular to it. Use only sufficient foliage to break up the characteristic outline of the barrel and produce a textured surface. Figure 31 shows a properly camouflaged tank. If correctly applied, the camouflage will be retained satisfactorily throughout rugged cross-country travel. The foliage

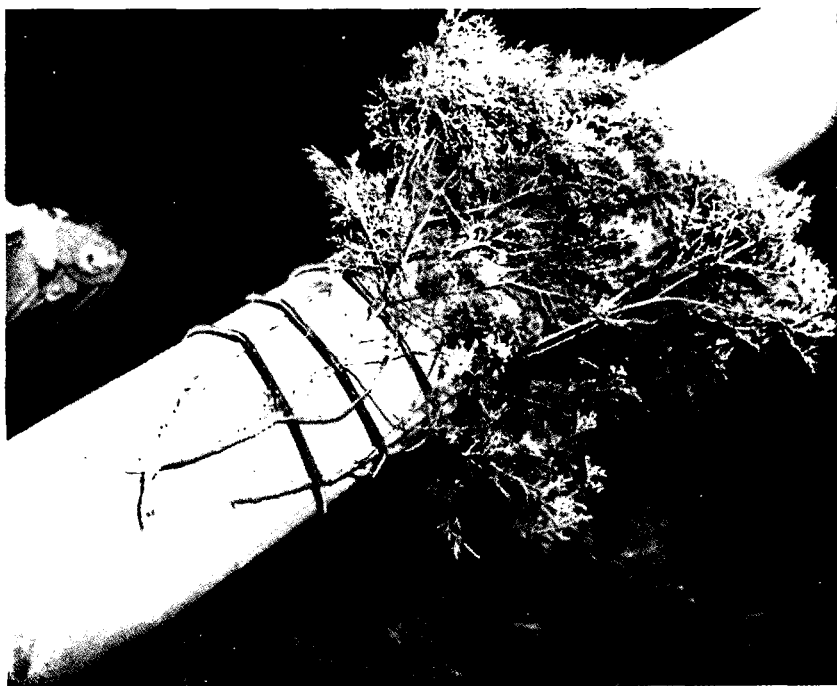


Figure 30. Clip fastened to gun barrel showing how natural garnishing is attached.

near the muzzle will be destroyed when the gun is fired. However, damage to the clips will be negligible except on the 120-mm gun and those guns equipped with muzzle breaks. Damage may be repaired as explained below.



Figure 31. Properly camouflaged tank employing brackets and clips.

(f) Maintenance.

1. *Clip.* All clips are chemically treated to prevent rusting. They do not require painting. Repair bent or broken fasteners by hammering or welding. If the springs become stretched, tighten them by cutting a section from one end as described in paragraph 2(c).
2. *Camouflage.* Fresh, live foliage, native to the area in which the vehicle is to operate, should be used for each engagement whenever possible. Wilted and broken foliage offers little camouflage. Try to select foliage which is durable and will stay fresh for a long time. The following types have been found most desirable: spruce, pine, cedar, oak, fir, and beech. Avoid types such as willow, aspen, ash, locust, and maple.

CHAPTER 3

COLORING AND PATTERNING MATERIALS

Section I. PRINCIPLES OF COLORING IN CAMOUFLAGE

13. General

a. *Use of Color in Camouflage.* Color is the sensation produced by the effect of waves of light striking the retina of the eye. Coloring is extensively used in all camouflage, and is particularly helpful in the front lines where men and equipment are continually under close range observation. The art of blending, the matching of the color of the object to be camouflaged with the color of its environment or background in order to effectively reduce contrast, must be practiced whenever an area is to be effectively camouflaged. There are three factors relevant to color; hue, value or tone, and chroma.

- (1) *Hue* is that quality whereby one color (as red) differs from other colors (as blue, green, etc.).
- (2) The *value* or *tone* of a color is its degree of lightness or darkness. The texture of the surface can be an important factor in determining color value. Smooth surfaces reflect light better than rougher surfaces.
- (3) *Chroma* is the saturation or degree of brilliance of a color determining whether the color appears to be pastel or brilliant.

b. *Appearance of Colors.* In nature, most colors appear in comparatively neutral values. Artificial or man-made materials and objects normally appear in a variety of hues and values, in contrast to the more neutral colors of nature. Colors used in camouflage duplicate closely the colors found in nature. These have been standardized and include colors for use in varying climates, seasons, and locations. Figure 32 shows the standard camouflage colors, including black and white. Important points to remember are—

- (1) When matching colors, duplication of color value must be adhered to, whereas small differences in hue and saturation can be tolerated. When a desired color is not available, any color of like value may be substituted and will provide at least partial protection.
- (2) In aerial naked-eye observation, colors tend to become grayed or neutral at a distance of 10,000 feet or more.
- (3) In panchromatic photography, all colors appear as gray of varying values.
- (4) Infrared photography also reproduces colors in values of gray. However, the subjects appear in a smaller tonal gray scale range, tending more toward either truer white or darker gray. For a fuller discussion on the use of photography in camouflage detection see FM 5-20.

Section II. ARTIFICIAL COLORING MATERIALS

14. Paints

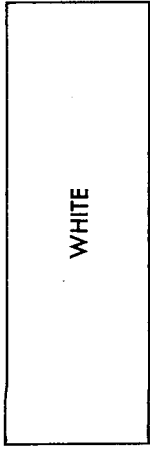
a. General. Commercial paints and stains are the most common materials used for coloring surfaces. However, other materials can be used to change the color of a surface—for example, used crankcase oil, crude molasses, and native coloring earths in the form of mud. The choice of a coloring material for a particular job is determined by—

- (1) Color desired.
- (2) Surface on which it is to be applied.
- (3) Finish desired—mat or glossy.
- (4) Climatic conditions—temperatures, rainfall, and the amount of brilliant sunlight, which influences the fading rate.
- (5) Availability.
- (6) Durability required.

b. Sources. In combat zones, the choice of paints is determined by availability. Normally, issue paints are available; but if not, supplies may be procurable from the depots of friendly forces, or captured enemy supplies can be used; local commercial products may be used; or, if necessary, materials may be manufactured by field-expedient methods.

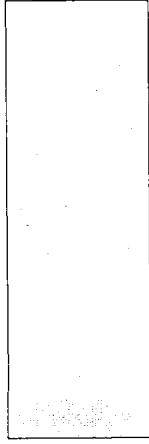
c. Correct Use. To obtain the best results, paints must be used in accordance with the climatic weather conditions for which they are suited. Paint failure usually is caused by improper mixing, unfavorable conditions, improper application, or by applying a paint covering which is not suited to the surface to which it is applied.

d. Requirements. Normally, the requirements of camouflage



WHITE

No. 1.—White



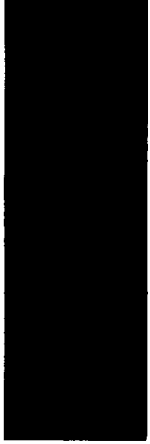
No. 2.—Desert Sand



No. 3.—Sand



No. 4.—Earth Yellow



No. 5.—Earthy Red



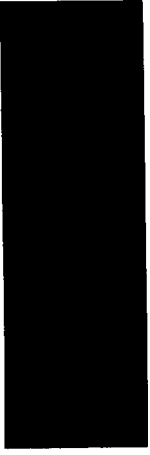
No. 6.—Field Drab



No. 7.—Earth Brown (Dark)



No. 8.—Olive Drab



No. 9.—Light Green



No. 10.—Dark Green (2#)



No. 11.—Forest Green (12#)



No. 12.—Black

Figure 32. # Standard camouflage colors.

paint are that it have a dull finish, be nonfading, infrared reflectant, and be able to cover in one coat. Most camouflage paints obtain the quality of infrared reflectance from natural earth pigments used to give them their color. Green camouflage paints, however, obtain their infrared quality from chromium oxide. Because of the important strategic value and scarcity of chromium it is essential to avoid waste or misuse of green camouflage paints. Their use is justified only where it is vital that green painted surfaces should photograph on infrared film with the same value as adjacent vegetation. Ordinary green paints, when so photographed, appear dark, whereas infrared-reflecting camouflage paints appear light, as does natural deciduous vegetation. For detailed information on camouflage paints see tables in appendices II and IV.

e. Field-Expedient Paints. To make paints (tables XIII–XX) in the field from local materials requires ingenuity, but there are few localities where suitable earth pigments are not available. In civilized regions, local paint manufacturers may be employed. In other regions, native labor and materials may be used. Suitable binding mediums may be known and used by local natives, and it will pay to investigate native practices. In West Africa, for example, copal, a resinous gum, is available and is made into a varnish by the natives. It dries quickly, makes a good bond, and when combined with local colored earth pigments makes a satisfactory paint.

(1) The following procedures may be a guide in the manufacture of field-expedient paints:

- (a) Search for source of various colored earths, rocks, or clays.
- (b) Determine binding medium to be used.
- (c) Select site for a field shop with regard to location of pigments, raw material for binder, water, availability of transportation, equipment, and labor.
- (d) Obtain or build necessary processing equipment.

(2) The range of pigments depends on the variety of local clays and rocks. The principal pigment not usually available in nature is black. Two methods for making black pigment are described in the paragraph below. Normally, local earths must be processed before use to obtain a uniformly fine texture. Colored earths from large ant hills, in regions where they are common, have been found to provide better and more easily ground pigment than other sources in the same region. Earths with a heavy sand content do not make good pigments. Colored earths are first dried, and then treated in field-expedient equipment.

(3) *Constructing the equipment.*

- (a) Drill a hole through a 55-gallon oil drum. Insert in the hole a length of pipe to serve as an axle and fasten it as shown in figure 33.
- (b) Attach handles to ends of the pipe so that the drum can be revolved. Place the drum on a frame so that it is supported by the axle.

(4) *Mixing the pigment.*

- (a) Place ten round granite rocks, each about 4 inches in diameter, inside the drum. Add two bucketsful of roughly broken pigmented material.
- (b) Close the top of the drum and turn the drum until the pigment has been well powdered.

(5) *Constructing a pigment-collecting chamber.*

- (a) A field-expedient pigment-collecting chamber (fig. 34) may be constructed as follows:
- (b) A boxlike structure, 72 inches high with a 19- by 19-inch section, is made with one side removable. Crushed pigment is poured into the top. At the bottom is a drawer to catch heavy pieces of pigment. The light pieces settle on metal collecting shelves, $2\frac{1}{2}$ inches deep, which are fastened to the inside of the chamber at 9-inch intervals. The positioning of the removable shelves, and a means of attaching them to the sides of the chamber using slots cut to receive screw or nail heads, are both shown in figure 34.
- (c) For best results the chamber should be plumb. The heavy material which falls into the drawer at the bottom is repoured through the top until all the light particles have been collected in the collecting shelves. Then the removable side of the chamber is opened and the usable pigment removed from the collecting shelves.

(6) *How to make a black pigment.*

- (a) Used coffee grounds are placed in a bucket or suitable container and heated over a fire. Eighteen pounds of coffee grounds produce a pound of pigment. The fire should have a low flame to prevent ignition of volatile smoke; in case of ignition, a cover is placed over container to snuff out flame. Occasional stirring is necessary to obtain homogeneous charring and to prevent oxidation of the carbon formed. Mixing or stirring is increased as heating progresses; in the last stage continuous stirring is maintained. When the thick smoke stops, it signifies the volatile matter has been

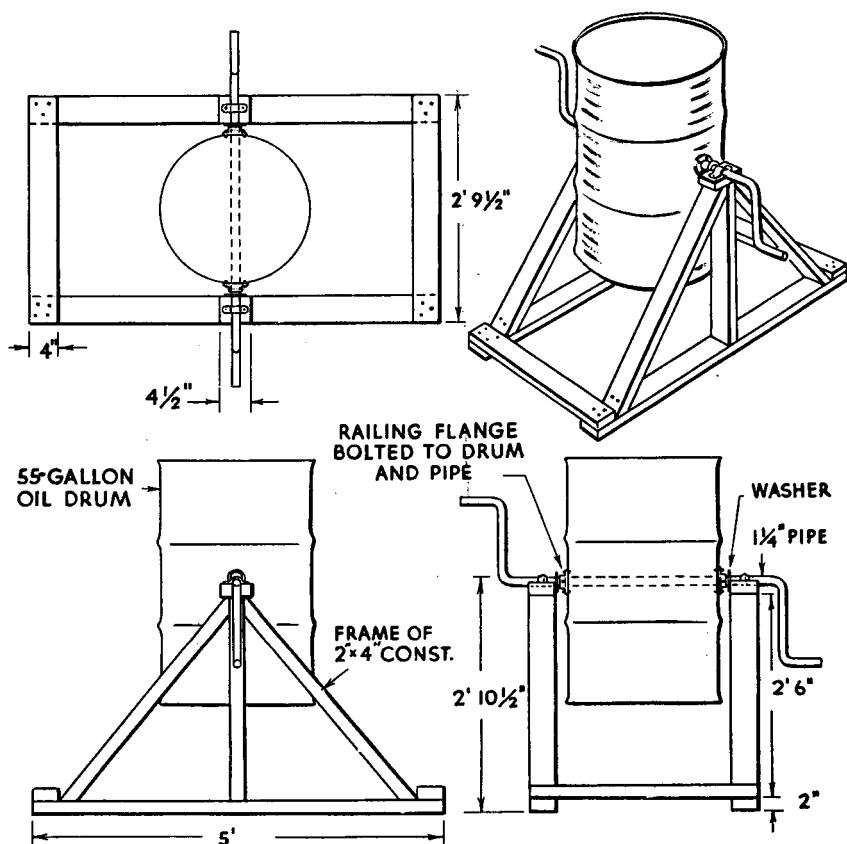


Figure 33. Turning barrel for pulverizing pigment.

removed and the grounds are thoroughly carbonized. This carbon must be transferred to a closed container to allow the material to cool without the carbon oxidizing. It is then ground by any suitable means and the resulting powder sifted through a fine screen. The finer the powder, the better the paint.

- (b) A black pigment also can be obtained by thorough burning of crankcase oil.

15. Methods of Applying Colors and Types of Painting Equipment Used

a. Methods of Applying Paints and Other Coloring Materials. Paints and other liquid coloring materials are applied by spraying, brushing, spreading, or dipping the object in the solution. Sprayers and other equipment for painting are available as items of issue and many field-expedient methods can be improvised.

b. Portable Paint Spraying Unit. The sprayer unit, paint,

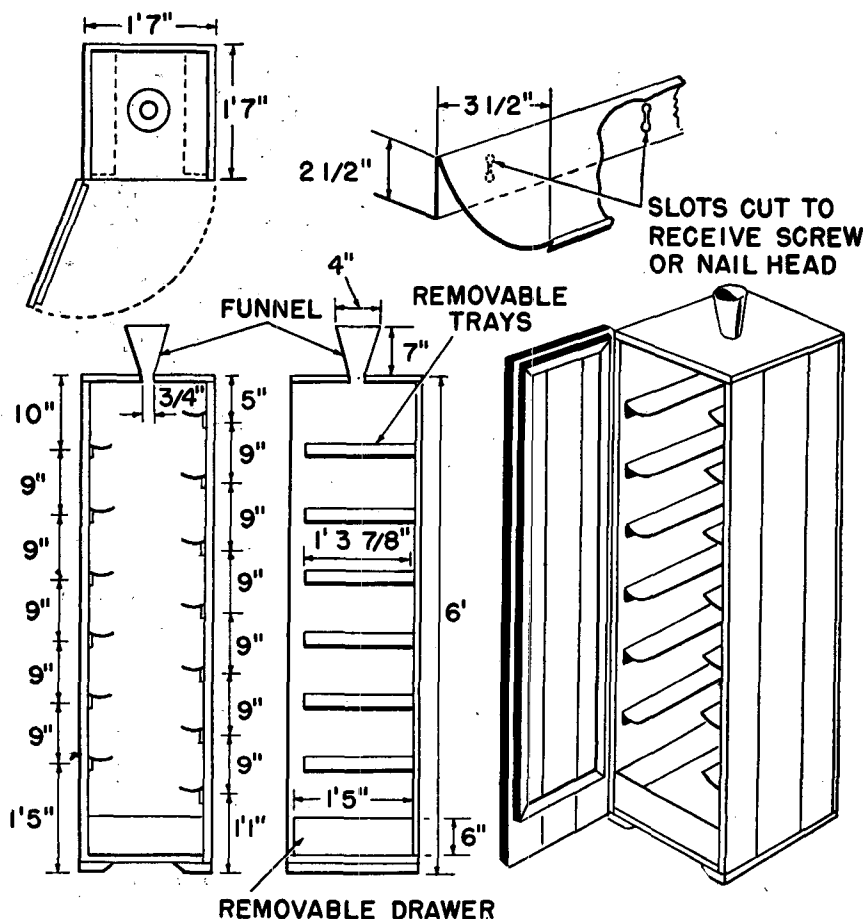


Figure 34. Field-expedient pigment-collecting chamber.

pneumatic, gasoline driven, wheelbarrow type mounting, (fig. 35), is an item of engineer supply (ENG 3-40). It is issued complete with guns, hose, accessories, tanks, tools, and spare parts which are contained in a hand portable chest. This is a lightweight unit used for covering small areas. It is suitable for the application of oleo-resinous, protein-binder, and oil-base paints but normally is not used for the application of bituminous emulsion adhesive. A coverage of approximately 2800 square yards in an 8-hour day can be attained. It also can be connected to a motorized air compressor. The component parts are—

- (1) Gasoline-engined air compressor and air tank mounted on wheelbarrow frame.
- (2) Two pressure tanks, portable, 5-gallon.
- (3) Two paint guns.
- (4) One nozzle extension for painting beyond normal length.

- (5) One set of hose.
- (6) Accessories, spare parts and tools.
- (7) One chest.
- (8) A technical manual which covers its operation and maintenance.

c. Operating Procedures for Portable Paint Spraying Unit. The paint is mixed and poured into one of the insert pails, which then is placed in the paint tank. The use of insert pails eliminates cleaning out the tanks and is convenient in changing quickly from one color or type of liquid to another. If both tanks are used, two colors can be applied simultaneously. As soon as the last paint has been applied, the equipment—especially the hose and paint guns—is cleaned. This is done by filling the insert pails with a solvent for the particular paint used and blowing this liquid through the hose and guns. The guns then are taken down and cleaned. If this is not done within 15 minutes the hose becomes clogged.

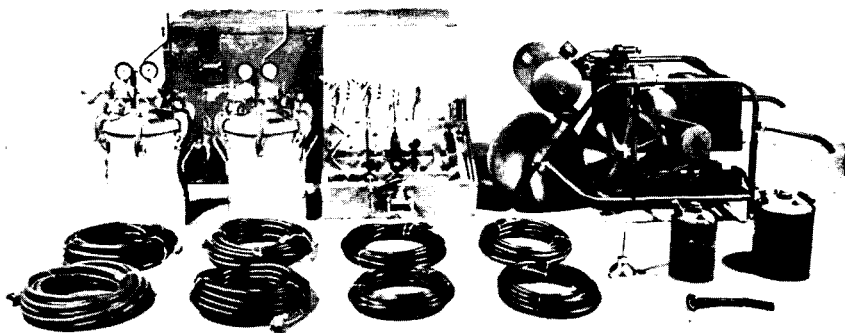


Figure 35. Portable paint-spraying unit.

d. Portable Bituminous Sprayer. This portable, self-contained unit is designed for spraying large horizontal surfaces (fig. 36). It is especially suitable for the application of bituminous emulsions, both paint and adhesive, cutback asphalt, used crankcase oil, and liquids of similar viscosity. A nonstandard item, it was designed to operate directly from paint drums of 55-gallon capacity, but as most drums have bungs in the end and not on the side, the liquid must be transferred from the original drum before use. It will operate in temperatures between minus 20° F. and plus 110° F. A coverage of 2,000 square yards in an 8-hour day has been attained. The component parts are:

- (1) Gasoline engine and air compressor and 55-gallon drum mounted on a 4-wheeled dolly.

- (2) Two spray guns, approximately 4 feet long, with 5 interchangeable nozzles.
- (3) Two 20-foot hoses.
- (4) Attachments, spare parts, and tools.
- (5) A technical manual which covers operation and maintenance.
 - (a) The equipment is not capable of being towed behind a vehicle even at low speeds. It may be drawn by hand without damage but for long distances must be transported in a truck.
 - (b) Care must be taken not to build up excessive pressure (30 pounds per square inch is normal) in the paint drums, which may have been weakened by shipment; otherwise there is danger that the drum will explode. For safety, be sure the clamps on the drum heads are tight before air pressure is built up within the drum.

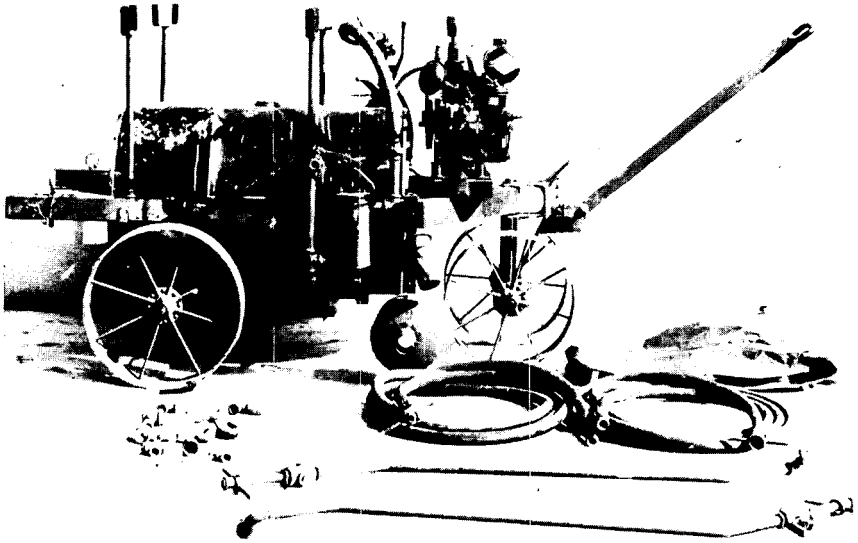


Figure 36. Portable bituminous sprayer.

e. Field-Expedient Sprayers. The improvised sprayers shown in figure 37 have been successfully used in the field.

- (1) Three sprayers of the type shown in 1, figure 37 can be supplied by one compressor truck. To operate, insert the paint intake tube, approximately 2 feet long, through a hole near the top edge of one side into the paint container, (a half gas can with handle carried by the operator). The end of the tube should reach as near the bottom of the can as possible. The spray gun is held

slightly below the level of the paint container to provide some gravity feed until sufficient air suction is obtained. A relatively thin mixture of paint, approximating the consistency of light cream, is used. Dilution to this extent is necessary to enable the gun to work satisfactorily. A second application is necessary at times. Coverage averages 30 square yards per gallon. Three men, each with a spray gun, can cover 300 square yards in 1 hour.

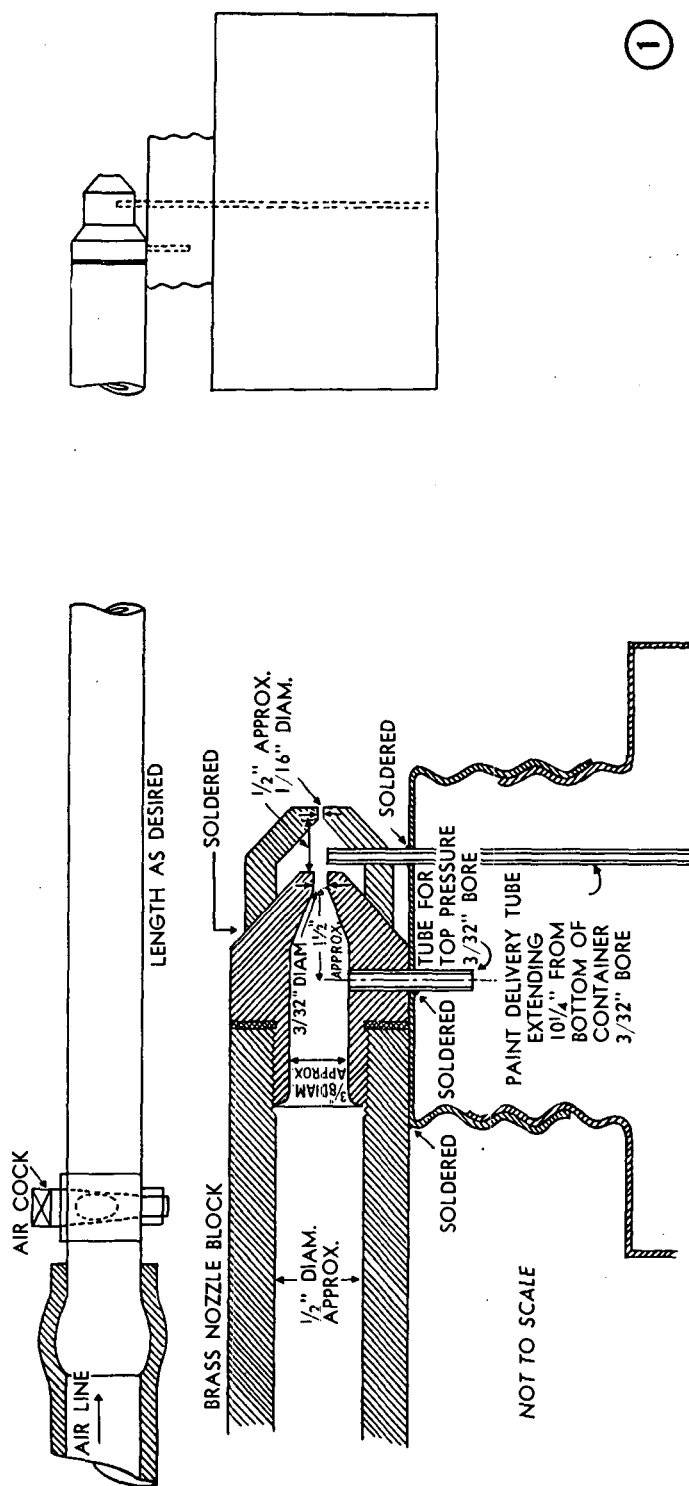
- (2) A more elaborate field-expedient sprayer developed in the field is illustrated in 1, figure 37.
- (3) An alternate sprayer made from ordinary plumbers' supplies is illustrated in 3, figure 37. The valve connections, pipe, and hose used should all be of the same internal diameter. Diameters ranging between $\frac{3}{8}$ inch to $\frac{1}{2}$ inch, both inclusive, are recommended.

f. Commercial Sprayers. When issue spray equipment is not available, civilian and commercial sources may be able to supply it. Considerable variation in the types of commercial paint sprayers will be encountered, but when need arises almost any spraying device may prove useful. Sprayer equipment not intended for the application of paint, such as fire extinguishers, stirrup pumps, golf-course spray equipment, disinfectant or orchard sprayers, may be locally procurable and may serve or be adapted to serve the purpose. Care must be taken to determine which equipment is adaptable to the application of the particular paint or adhesive desired.

g. Paint Mixers.

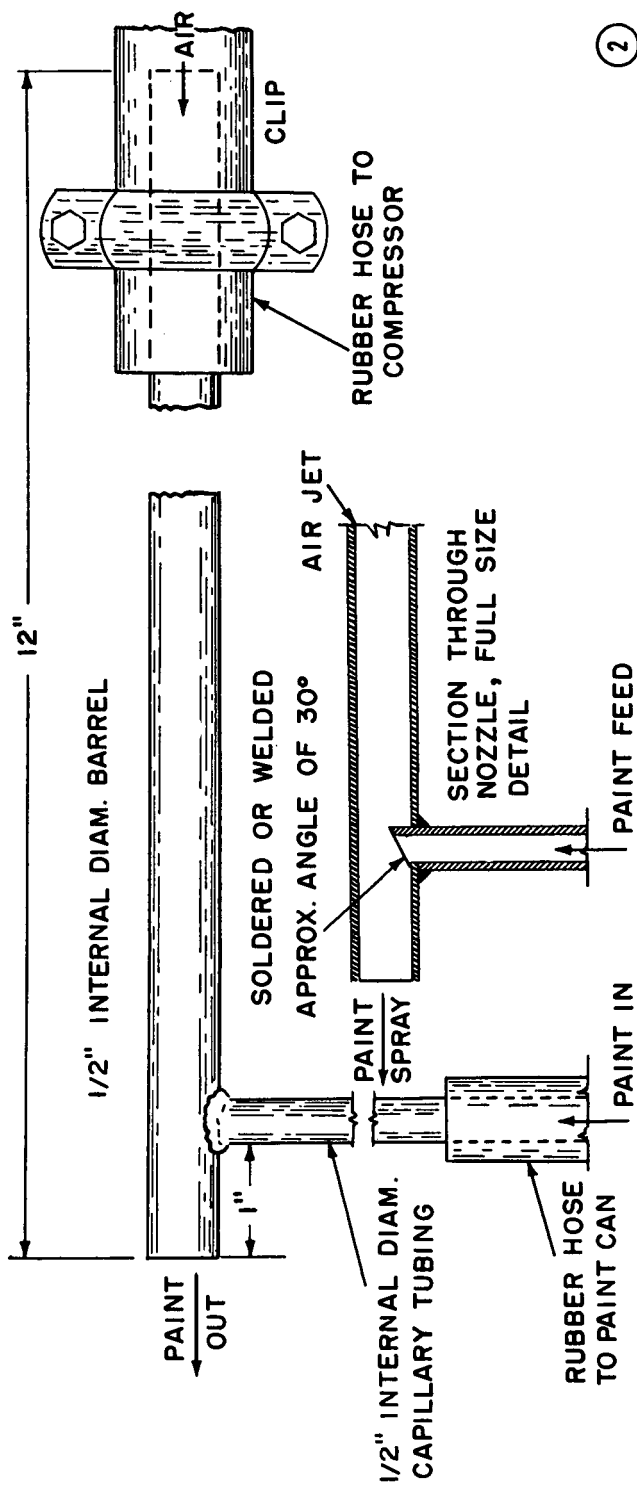
- (1) An issue pneumatic agitator for mixing paints is available as an item of engineer supply (ENG 3-40). The component parts consist of—
 - (a) Motor, air driven, with a 27-inch propellor shaft.
 - (b) Two propellers.
 - (c) A clamping device for attaching agitator to a 50-gallon drum.
 - (d) Spart parts.
- (2) Also issued is a motor driven paint agitator similar to the above, except that it is electrically powered and is equipped with a 50-gallon mixing tank. This is listed in ENG 3-40. Its component parts are—
 - (a) Mixing tank with outlet valve.
 - (b) Mixer, electric, powered with two propellers.

h. Field-Expedient Paint Vats. As shown in figures 38 and 39 vats for coloring fabrics or cloth by dipping are easily constructed. A 5-gallon bucket, ammunition box, or any watertight



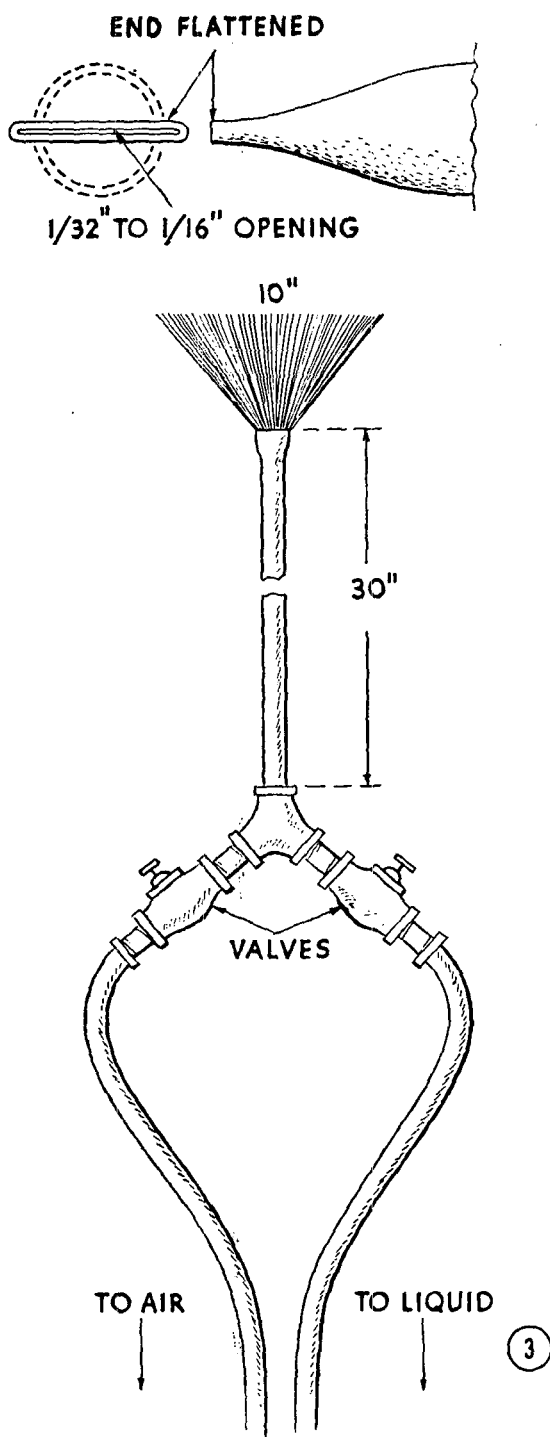
1 Suction type sprayer.

Figure 37. Types of field-expedient sprayers.



2 Sprayer with fly-gun container.

Figure 37—Continued.



3 Expedient sprayer.
Figure 37—Continued.

container may be used. The fabric is cut into 5-foot lengths and dipped into the vat so that both sides are completely covered with paint. It is then lifted out, folded in half and placed on a drain trough, and the excess paint is removed by rolling. The wringer type paint vat (1, fig. 39) enables greater production and is more economical on paint. A smaller type vat as shown in 2, figure 39 employs the use of a 12-inch roller wringer which is mounted on the side of the vat.

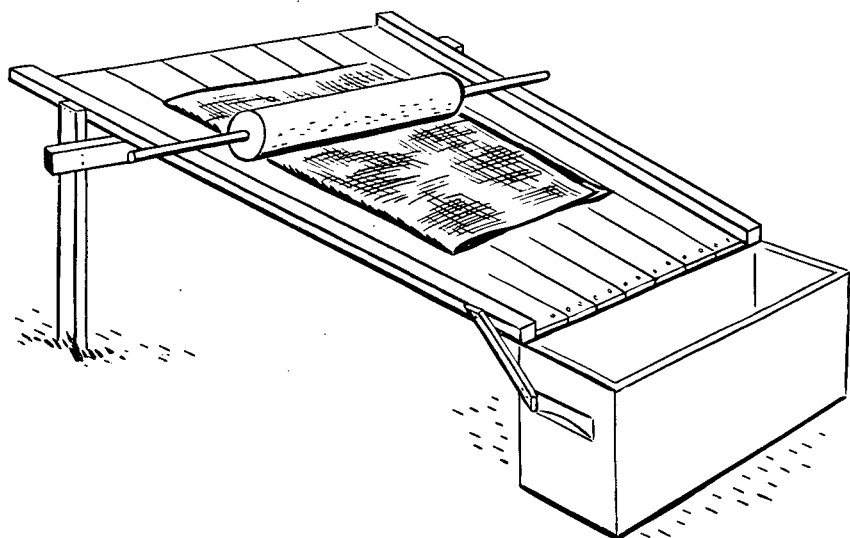
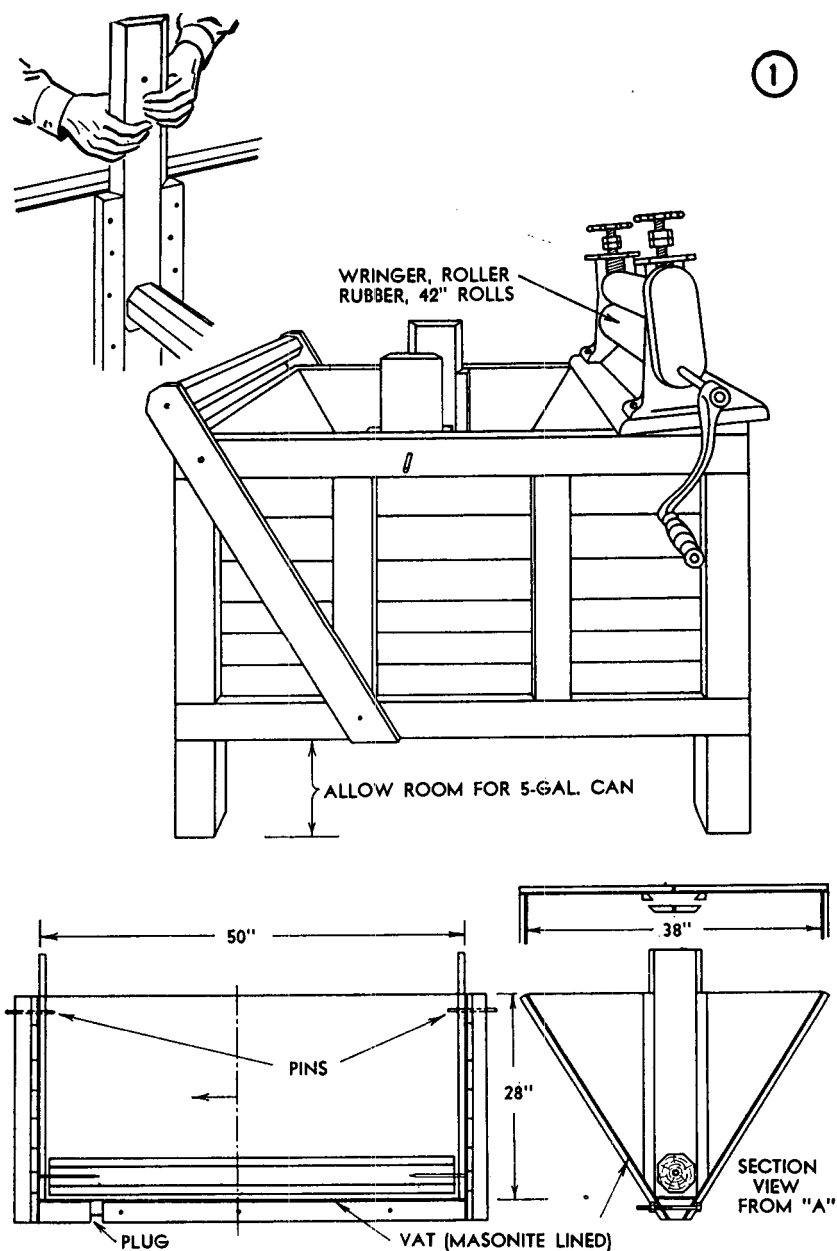


Figure 38. Field-expedient paint vat.

i. *Construction of Drying Racks.* Figure 40 shows the construction of field-expedient drying racks. Fabrics will dry more quickly when spread on racks and they should be used if the time is available.

j. *Paint-Dipping Rolls of Garnishing Materials.* Strips of fabric for garnishing materials may be color-dipped by using the field-expedient apparatus shown in figures 41 and 42.

- (1) Four rolls of precut garnishing fabric are mounted on an axle supported by a wooden stand (fig. 41). The rolls are carried down into a galvanized iron can which has a wooden frame wedged into the sides. Nails act as guides. After being threaded through the wringer, the ends of the strips are wrapped around a stick; while one man steadies the can two others grasp the stick and slowly pull the colored garnishing strips through the wringer. The men walk slowly away from the vat in a straight line for a suitable distance, to enable the un-



1 Paint vat of wood, with wringer.

Figure 39. Types of expedient paint vats.

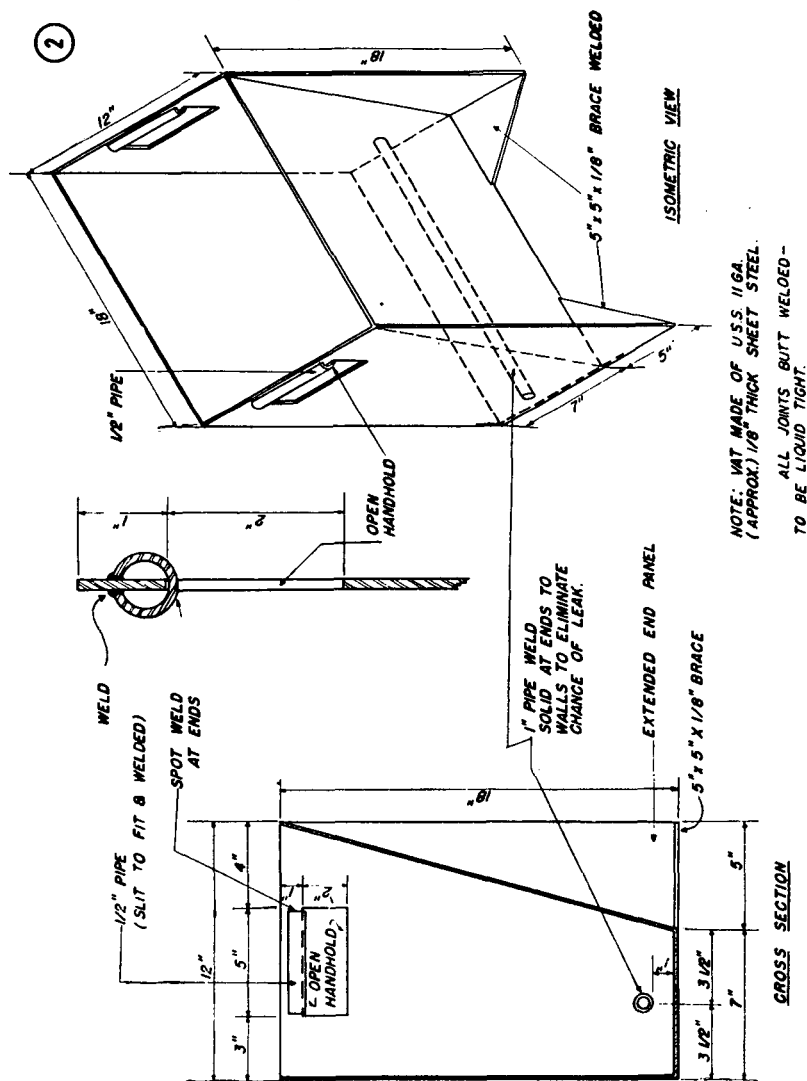


Figure 39—Continued.

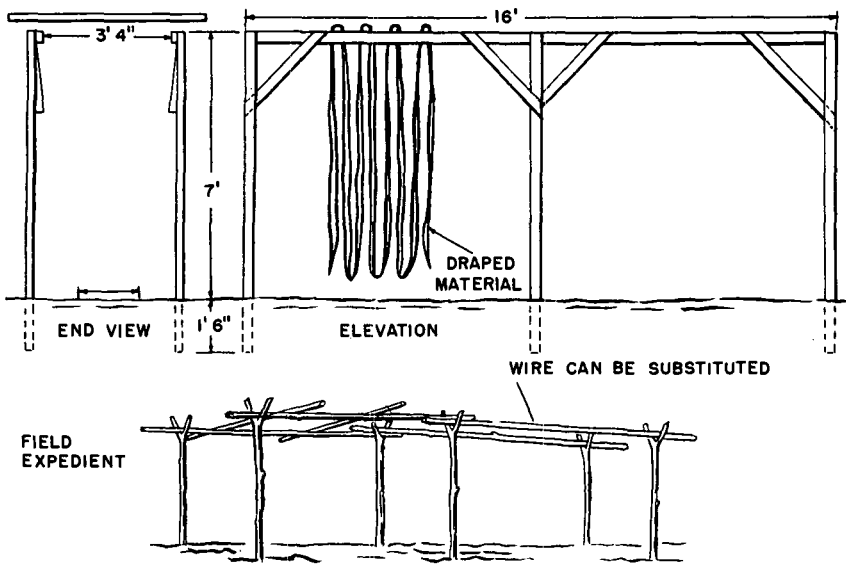


Figure 40. Construction of field-expedient racks.

rolling of convenient lengths, and lay the colored strips on the ground to dry. The strips then are cut off close to the wringer, the equipment moved slightly to the right or left, and the process repeated.

- (2) If an ammunition box is available for use as a paint vat, a more compact apparatus can be built by supporting an axle between two extension arms set into pockets on both sides of the paint vat (fig. 42). The extension arms, the two driftpins which guide the cloth through the vat, the driftpin slides and the bracing stick are removable. The vat is held in place by driftpins which are driven into the ground through large staples or bent spikes placed on the corners. When not in use, the removable parts are placed in the box. Method of operation is the same as in (1) above.

16. Painting and Preparing Large Quantities of Fabric Garnishing Materials

a. Field Plant for Painting and Preparing Garnishing Materials. When it is necessary to process large quantities of bolted fabric to make garnishing strips, a field plant is set up. Figure 43 illustrates the organization of such a plant. Bales of uncolored fabric are brought in by truck and piled within convenient distances of the paint vats. The supply of paint is spotted near the paint mixers and the water supply. This should, if possible, be

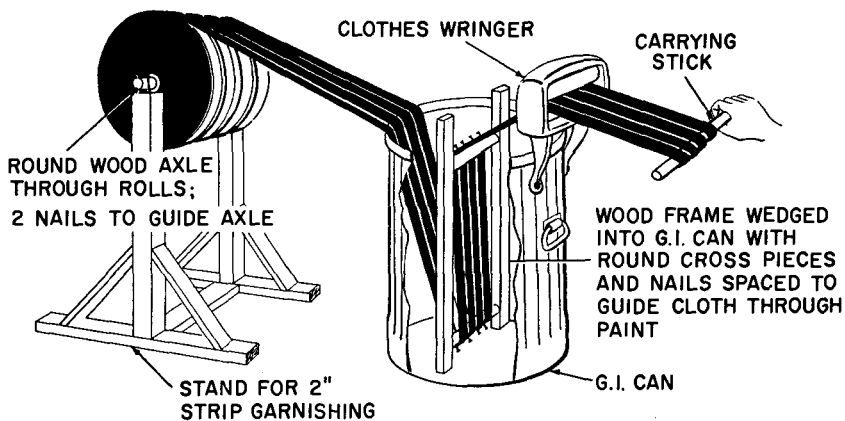


Figure 41. Apparatus for coloring rolls of fabric.

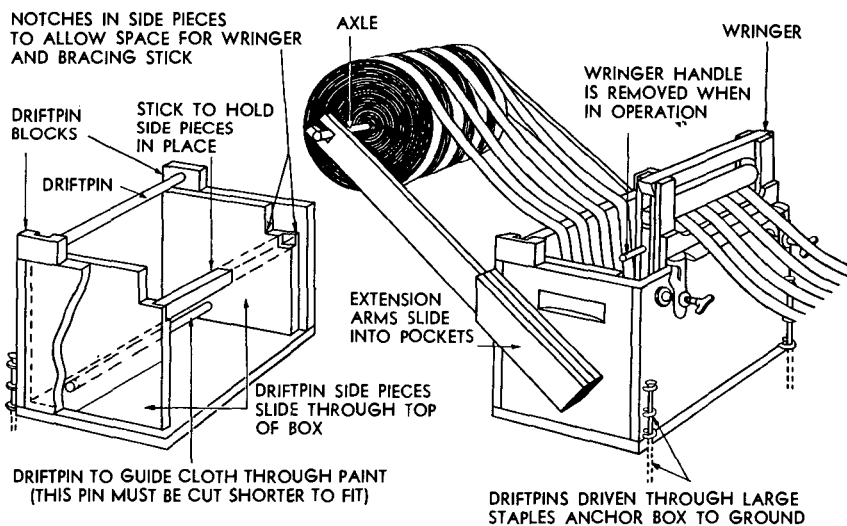


Figure 42. Field-expedient paint vat for coloring garnishing strips.

pipied in. Bolts of fabric are laid out conveniently and the mixed paint carried by bucket to the paint vats. The fabric then is passed into the paint vat, through the 42-inch wringer and wound on the reel. It then is dried on the drying racks and taken to the cutting tables where it is cut into strips. From there the strips are stacked and bundled in racks and are ready to be used in the net-garnishing operation. Figures 44 and 45 show construction of reels and cutting tables.

b. Cloth Cutters.

- (1) For cutting garnishing strips in the above field shop method, a rotary, electric powered cloth cutter is issued.

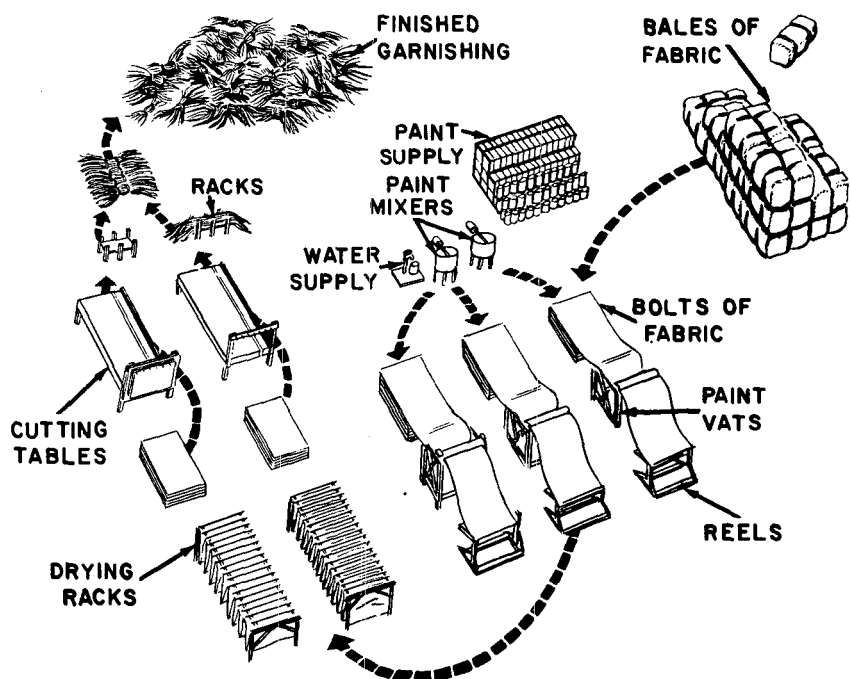


Figure 43. Operational diagram of field plant for coloring fabric and making garnishing strips.

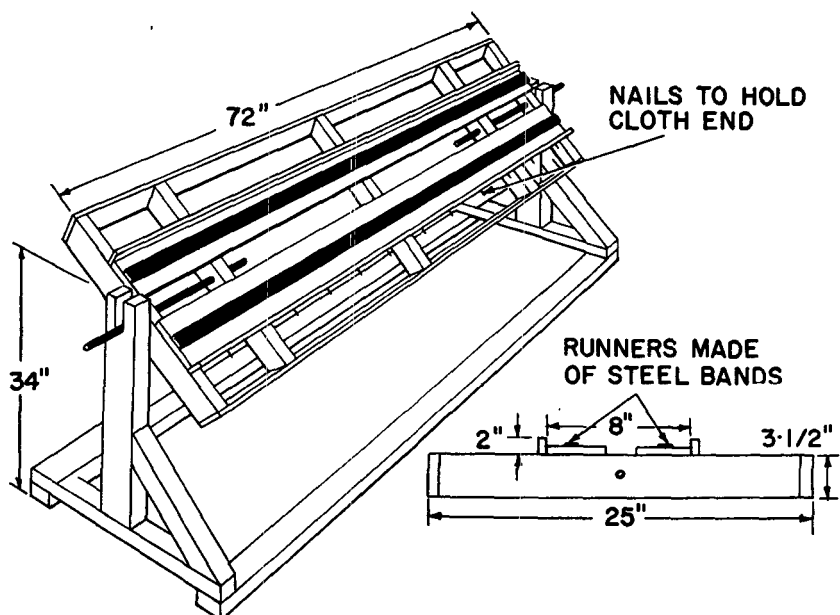


Figure 44. Construction diagram of reel.

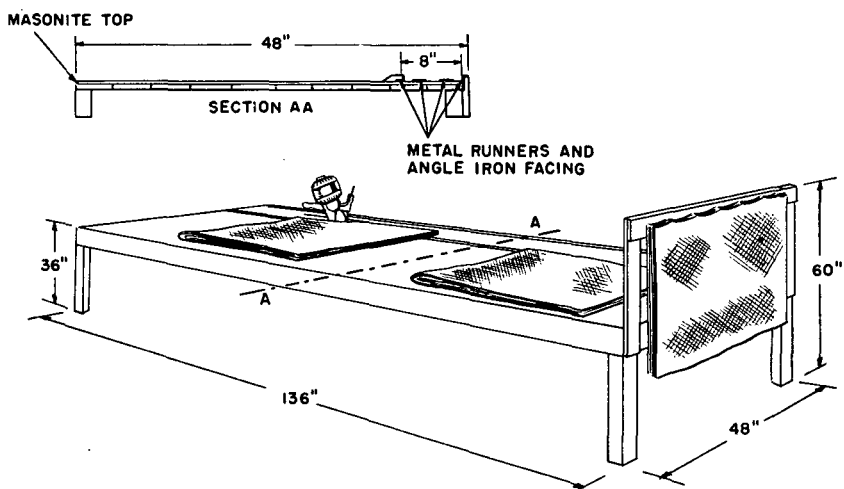


Figure 45. Construction diagram of cutting table.

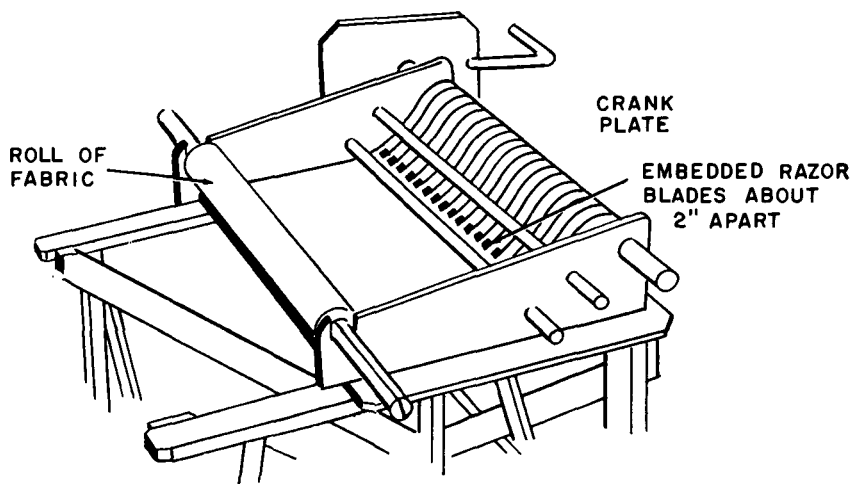


Figure 46. Machine for cutting garnishing strips.

- (2) If electric cutters are not available, a field-expedient cutting machine can be made as shown in figure 46.
- (3) A hand method that uses a sharp hatchet for cutting fabric into 2-inch or other desirable width garnishing strips is shown in figure 47. The 2-inch width is standard for garnishing strips to be used in the standard cotton-twine net, the meshes of which are $2\frac{1}{4}$ -inch squares.

c. Materials Required, Working Party, and Production Schedule for Workable Field Factory.



Figure 47. Rolled fabric being chopped by hand into garnishing strips.

- (1) The tools and equipment include—
 - 3 Paint vats, 25-gallon capacity, built by unit (fig. 39).
 - 3 Wringers, roller, rubber, 44-inch.
 - 3 Reels for winding dipped fabric, built by unit (fig. 44).
 - 5 Electric cloth cutters.
 - 2 Cutting tables, built by unit (fig. 45).
 - 2 Machines, paint-mixing, 50-gallon capacity.
 - 1 Generator set, portable 3 KVA.
 - Water supply—piped in, if possible.
 - 3 Stands for rolls of garnishing strips, if required.
 - 1 Drying rack (length determined by current needs (optional)). Hatchets, shears, knives (if electric cutters are unavailable).
 - 2 Racks for garnishing strips, built by unit (fig. 40).
- (2) Cloth painting and cutting detail for the field plant may be organized as follows:

<i>Enlisted men</i>	<i>Duty</i>
3	Mixing paint.
1	Guiding bolted fabric into paint vat.
1	Guiding painted fabric into wringer.

Enlisted men

Duty

- 3 Operating wringer (alternating).
 2 Winding cloth on reel.
 1 Cutting reeled cloth.
 2 Baling and carrying cut cloth.
 5 Per electric cutter at cutting tables for
 cutting garnishing strips.
 2 NCO supervisors.

- (3) The chart which follows gives an approximate basis for estimating rate of production. With this procedure 112,500 garlands have been manufactured per 8-hour day.

Process	Unit of production	Man-hours per unit	Number of men
Painting 40-in. bolted burlap (including mixing paint).....	100 yards.....	2.50.....	12
Cutting garlands from 40-in. bolted burlap:			
(a) Hatchet method.....	900 garlands.....	8.00.....	5
(b) Electric cutter.....	900 garlands.....	1.50.....	5
Cutting 2-in. rolls with electric cutter.....	900 garlands.....	0.70 to 1.30*.....	6

*Variation is caused by production of rolls of several colors, some of which are easier to cut than others.

17. Stains and Dyes and Other Coloring Materials

a. General. In addition to the paints listed in tables I through IX, other materials and methods may be used for coloring surfaces (tables XI to XX).

b. Primers. Priming coats normally are necessary only on surfaces not previously coated. The principal use of primers (table IX) is to increase the covering power of camouflage paints and thus reduce cost, and in the case of metal surfaces to provide an impermeable film to prevent corrosion. Their use also facilitates the adhesion of the paint.

c. Stains and Dyes. Stains (tables XI and XII) are of less value than paints because they lack durability, provide little protection from weathering and abrasion, and have less stability of color.

- (1) Issue fabric dye and canvas-refinishing compounds (tables XV and XVI) are efficient for the use for which they are intended.
- (2) Native dyes, such as indigo, cochineal, and gamboge, have little durability and color permanence, and their use is not recommended. Certain natural materials can be used to produce dyes to color fabric if issue or commercial paints are unavailable. For example, a red dye can be made from the inner bark of birch trees and from sorrel roots; a blue dye can be made from elderberries, from the roots of yellow iris, and from the berries of

the privet with the addition of alum and salt; a yellow dye can be made from the inner bark of crabapple or ash trees, from the stem and roots of the barberry, and from the leaves of birch trees; a green dye can be made from the bark of the elder, from the bark of larch trees with the addition of alum, and from the leaves of the lily of the valley; a brown dye can be made from the bark of oak, birch, or alder trees, from the roots of walnut trees, and in the autumn from pine needles; and a black dye can be made from alder bark, from the roots of the blackberry with the addition of salts or iron, and from the bark of the elder with the addition of coppers.

- (3) Dyes are most easily made from these natural materials by using a boiling-out procedure such as that fully described for the extraction of adhesive from natural materials in table XXII.

d. Dyeing Troop Clothing. When a requirement exists for the dyeing of large amounts of troop clothing in the field, the availability of commercial laundry unit facilities should first be explored. Such facilities would normally include stocks of dyes, and equipment capable of handling expeditiously large amounts of clothing. Where such facilities are not available, the following expedient process can be used.

- (1) Tie knots in clothing so that dyeing will result in a mottled rather than a solid color.
- (2) Place clothing in a large twine net and lash the four corners together at the top of the bundle.
- (3) Procure steel vats; raise them on rocks or masonry high enough to allow fire pits to be built under them.
- (4) Prepare a dye solution (table XV) of the required color and pour it into the vats.
- (5) Build fires under the vats and heat the solution to the proper temperature.
- (6) Run a pipe, steel rod, or strong wooden pole under the lashing at the top of each bundle before immersing in vat. These rods or poles rest on the sides of the vat, thus supporting the load and preventing the bundles from being burned by touching the bottom of the vat.
- (7) Use a vehicular-mounted boom crane, or construct a boom derrick, for hoisting the bundles of clothing and lowering them into the dye vats.
- (8) Stir the dye solution constantly as long as the clothes are immersed.
- (9) Remove bundles by crane or derrick.

(10) Rinse thoroughly.

e. Chemicals. The use of chemicals is limited to altering the color of natural live vegetation, primarily grass turf. Those chemicals which are used for camouflage purposes are not regular items of issue. The two types of chemicals, fertilizers and killing agents, are discussed in detail in paragraph 21.

f. Face Paint for Individual Camouflage. Face paint for individual camouflage has been standardized and is procured, stored, and issued as a Quartermaster Corps item.

- (1) *Colors.* Face paint is supplied in stick form in a cylindrical metal container approximately 3" in length (fig. 48). Each stick contains two contrasting colors, permitting the application of disruptive patterns to exposed skin areas. Three color combinations are made: loam and light green for white troops in all except snowy regions; white and loam for use in snow country; and sand and light green for Negro troops.
- (2) *Characteristics.* Face paint is nontoxic. Water, perspiration, or contact with grass will not remove it. It contains an effective insect repellent. It can be washed off with soap and water.
- (3) *Basis of issue.* The basis of issue is as follows:
 - (a) *Theaters of operations.* One stick per individual in combat zones when authorized by theater commander.
 - (b) *Posts, camps, and stations.*

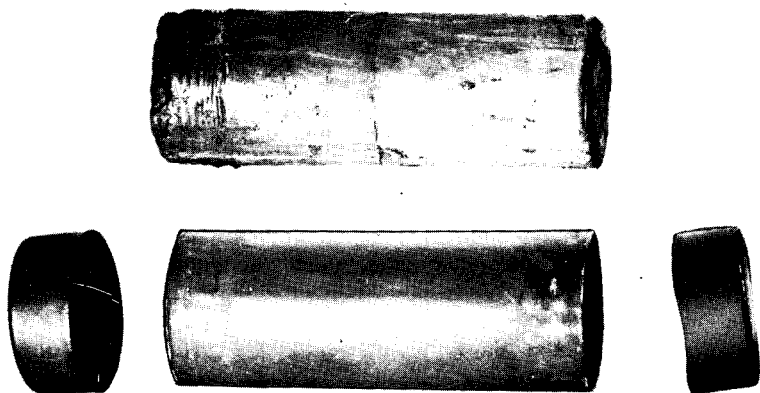


Figure 48. Stick of issue face paint disassembled.

Note that the paint stick at bottom of figure is made up of two contrasting colors. Removable caps at both ends allow access to either color.

1. One stick per 10 students in training centers during basic training.
2. One stick per 10 enlisted men in TOE units in the continental United States during Army Ground Forces or Army Service Forces basic training.
3. One stick per student in camouflage training courses in Army Ground Forces or Army Service Forces arm and service schools.
- (4) *Use.* Directions for application are contained in a sheet of instructions furnished with each package.

Section III. GROUND PATTERNING WITH ARTIFICIAL COLORING MATERIALS

18. General

Paint and paint substitutes are the artificial materials normally used for duplicating background patterns on surfaces so that these areas will blend into and become unobservable against their background. Details concerning the pattern painting of guns, planes, and similar equipment are found in FM 5-20, A through G. As discussed in this section, patterning applies to large, two-dimensional ground areas, such as runways, and is usually called ground patterning. Three-dimensional ground patterning is discussed in paragraph 22. It should be noted that patterning with coloring materials alone may not provide sufficient concealment and that texturing or other camouflage materials may therefore be required. Texturing materials for ground patterning are discussed in paragraphs 29 through 33.

19. Ground Patterning With Artificial Materials

a. General. Ground patterning is used primarily for the concealment of airfields, roads, small installations, and other open areas. Paint and other artificial coloring materials are used mainly for patterning relatively hard and smooth surfaces such as concrete runways and hard-surfaced roadways. Special caution must be observed in the use of coatings applied to runways, taxiways, and hardstandings used by jet aircraft. Bituminous emulsions and other coatings which leave a soft film on the ground surface should be avoided, since they may flame or soften under jet motor blasts causing both fire and skid hazards to other aircraft. For simple tone-down of surfaces used by jet aircraft, the stains described in tables XII and XLI are recommended.

b. Artificial Coloring Materials. Runway camouflage paints (table VI), bituminous emulsion, and cut-back asphalt (table

VIII) are issue materials. Expedient materials are crankcase oil (table XX), raw molasses (table XIX), or similar liquids.

c. Equipment for Applying Artificial Ground Patterning Materials. The mobile paint-spraying unit as described in paragraph 15 can be used for applying paint and other liquid coloring materials to large ground areas. The asphalt distributor is also an item of issue for this purpose. If this is not available, commercial asphalt distributors commonly used on road construction will serve as well.

d. Patterning of Roads, Runways, and Similar Areas. The particular pattern to be applied to an area is determined by the pattern of the terrain adjacent to the area to be colored. Patterns of cultivated fields, orchards, and the like may be closely simulated by the careful application of coloring materials in the appropriate design. Figure 49 shows the duplication of an orchard pattern and figure 50 a plowed field pattern applied to runways. In figure 51 the application of color and texture to a road area has caused it to blend into the background. Refer to other manuals of the camouflage series for complete details on the camouflage of airfields.



Figure 49. Ground view of part of simulated orchard pattern on runway.



Figure 50. Strips painted over textured runway to resemble ploughed field.



Figure 51. Section of roadway colored and textured to blend with adjacent terrain.

Section IV. GROUND PATTERNING WITH NATURAL MATERIALS

20. General

Ground patterning with natural materials usually is cheaper than with artificial materials. It is applicable to large areas also, such as airfields, and usually is used when the area to be patterned is of a semihard consistency such as sod, compacted earth, or turf.

21. Two-Dimensional Ground Patterning With Natural Materials

a. Spreading Materials Over a Surface. Two types of materials are used; cut vegetation or inert materials, such as soil, gravel, small rocks, and other loose material.

- (1) Plant materials, such as heavily leafed branches, dead branches, saplings, corn stalks, tumbleweed, sagebrush, reeds, cattails, kelp, spanish moss, chaff, vines, and tall-growing field grasses are among the available materials.
- (2) Inert materials are found in most localities in a considerable range of native earths of varying color and texture. Properly used, they change the ground pattern according to the camouflage scheme.
- (3) The choice of material and the method of distribution depends upon availability of material, the color and texture desired, climatic conditions (especially wind and rain), and the purpose for which the area is used. Strong winds will blow away light materials, and heavy rains will wash away thin layers of sand or earth used as covering materials. Fine materials may form dust clouds which are injurious to such equipment as aircraft. Normally, materials are spread more or less evenly over the surface to be treated. However, to secure the effect of a cultivated truck garden, individual tumbleweed may be arranged in rows and staked to the ground. They may be colored green by dipping or spray painting. Mulching is a good method to tone down scarred earth, assist dust control, and aid in the establishment of turf plants. Peat, muck, and straw are common materials used for this purpose.

b. Earthwork. Another of the basic means of ground patterning is accomplished by disturbing or breaking up the surface of the ground through use of earthworking equipment. By varying the method used, a considerable range of differently textured surfaces is obtained. Although surface *texture* may be changed by earthwork, it is the resulting color *pattern* that provides concealment. Ground patterning by earthworking is a relatively

quick method but normally is suited only to areas where farming or the clearing of ground is a common activity. This method should not be used where dust may be a menace and normally will be used only as a temporary measure to be replaced by seeding for grass. Engineer equipment, locally available farm or road-building machines, or improvised devices can be used in making the patterns. By varying the direction of drag, different patterns can be achieved from the same equipment in adjacent areas. Where necessary, this method can be used to obscure tracks and scars, especially those resulting from construction work. Applicable methods of earthwork include—

- (1) *Rooting*, which produces a rough, coarse texture, without geometrical pattern, on any surface, including soil containing rocks and boulders. This is accomplished very rapidly by an issue rooter pulled by a tractor.
- (2) *Plowing*, which produces a coarse texture with a distinct geometrical pattern over any surface except hard ground. It is accomplished by standard issue equipment (such as a tractor plow, disk plow, or gang plow) or by farming equipment.
- (3) *Scarifying*, which produces a coarse texture on most surfaces. It is ineffective where heavy sod occurs. The scarifying teeth on issue blade graders or rollers are used for this purpose.
- (4) *Cultivating*, which produces a medium coarse texture over bare ground and very light sod. Issue chisel cultivators or similar farming equipment are used.
- (5) *Harrowing*, which produces a medium fine texture and is recommended over plowed surfaces or bare ground which is not too hard. Issue equipment for this purpose includes the disk and spike-tooth harrow. A drag can be improvised to serve the same purpose by driving spikes or driftpins through a timber frame which is sufficiently weighted to bear heavily against the soil.
- (6) *Smoothing or blading*, which produces a smooth, textureless surface over bare ground. This is accomplished by the use of the blade on issue motorized or towed graders.

c. *Spot and Pattern Irrigation*. This is a means of developing patterns in turf in dry areas or during dry periods. This method is recommended for small areas, where it is particularly effective. If ample water supply and water distributing equipment are available, its use over large areas is possible. When watering, avoid saturation; saturation reduces the bearing capacity of the soil. To prevent too rapid drying, watering should be done in the late afternoon or at night.

- (1) In farming country, the watering of predetermined areas results in creating the effect of irrigated fields and crops. During a summer drought, watering confined to areas of an allover turf field alters the uniform drab color of the turf and simulates patches of alfalfa, clover, and other drought-tolerant field crops which remain green while the turf itself is ordinarily dormant.
- (2) If water-distributing equipment which is standard Corps of Engineers issue is unobtainable, other equipment may be improvised or borrowed from local farmers and other civilian sources.
- (3) To provide the amount of water equivalent to a natural rainfall of 1 inch, 27,000 gallons of water are required per acre of ground.

d. Burning Dry Grass. This offers one of the quickest methods of runway simulation. The darkened area so made normally lasts only a few weeks. No hard-and-fast procedures can be outlined for this method, but certain precautions must be followed, not only to obtain the intended result but to do it safely. The following sequence of procedure generally is applicable (fig. 52) :

- (1) The decoy runway or other area is first oriented, laid out, and staked.
- (2) The boundaries of the runway or area then are ditched or plowed so that a strip of soil is left bare of vegetation as a fire gap and to assure that the edges of the area are straight.
- (3) Adequate precautionary measures for fire control are taken. These include—
 - (a) Boundaries of the area to be burned are wetted by water sprayer.
 - (b) Trucks loaded with sand, brooms, rakes, shovels, or mobile fire-fighting equipment are sited at the area.
 - (c) Personnel are provided to control the fire.
 - (d) Fires are started only when winds are of less than approximately 10 miles per hour velocity. (At this velocity, leaves and small twigs are kept in constant motion; when branches begin to sway, the wind is greater than 12 miles an hour.)
- (4) Main fire is set on the up-wind side. At the same time, a smaller backfire is set on the down-wind side.
- (5) Level brush not flattened by fire to avoid irregularity of surface texture.
- (6) If burned area is not sufficiently dark, cutback asphalt or bituminous emulsion may be applied to, or a natural

black material, such as cinders, may be spread over, any light colored areas to darken them.

e. Grass Planting. This method provides a permanent and effective tone-down or two-dimensional ground patterning on bare or sparsely covered earth. It also is useful in preventing the formation of dust clouds which are visible for great distances. The discussion that follows is a condensed guide based on the three methods of grass planting: seeding, sodding, sprigging. Availability of grass seed, tools, and equipment depends on local conditions. Essential equipment may be improvised or converted from other primary uses for planting grass. Effective patterns to create the appearance of separate fields and diversified methods of culture are possible when strongly contrasting species are planted in adjacent areas as, for example, alsike clover and rye grass or cowpeas and grass. The most realistic ground patterns are made by combining planting with a planned system of control, using mowing, irrigation, and fertilizing.

- (1) Selection of grasses is limited to native or naturalized species suited to a particular locality. Attempts to use species outside this range almost invariably meet with failure.
- (2) Planting seasons vary considerably. Generally, in climates comparable to those found in the United States, the following statements apply:
 - (a) In cool humid regions, seeding of permanent species is done preferably in late summer or autumn. Temporary planting is done in spring or summer in these regions. Planting grass-seed mixtures is the common practice.
 - (b) In warm humid regions, seeding is done during spring or summer months. Planting unmixed seed is the usual practice.
 - (c) In dry regions, sodding or sprigging is done preferably at the beginning of the rainy season.
- (3) The best type of soil is a sandy loam. Topsoil may be saved and redistributed after grading. Some subsoils need no treatment to support the growth of grass. Sandy soil, however, should be treated by the addition of a stabilizing or binding layer of mixed clay and peat or muck. On the other hand, sand may be added to heavy clay soil.
- (4) Drainage is extremely important in the establishment and maintenance of turf fields. It should be remembered that water drains more slowly from turf than from pavement.

- (5) The type of preparation employed for the seedbed is influenced by the purpose for which the turf is planted, size of the area and the soil type; these have been discussed above. In this connection it must be noted that turf fields are impractical for use by fighter and larger Air Force aircraft. Army light aircraft may use turf runways so long as they are not disked, spiked, or otherwise too coarsely textured. After careful consideration of such factors, the procedure is normally as follows:
- (a) Grade the area with standard issue or commercial graders.
 - (b) On large areas, such as corps or army light air installations, the preparation of soil for planting sometimes can be accomplished in one operation by the use of an issue or commercial farm disk harrow. This operation may leave the seedbed in a rather rough condition, but because of the dust problem the rougher seedbed in dry areas is superior to one on which the soil has been finely pulverized. In tightly packed clay soils it may be necessary to use plows or other implements for tillage. If fertilizer is applied before the final disking, the same operation can be used to work the fertilizer into the soil and to break up the soil properly for planting. The fertilizer should not be disked into the soil below the level at which most of the grass roots will grow. At airfield sites even for light aircraft, most farm disks are not suitable unless followed by a drag or spike-tooth harrow because they are constructed to throw the soil two ways and cause formation of ridges unsafe for aircraft taxiing or runoff.
 - (c) On smaller areas, small disk plows or tillers may be used. On very small areas, hand spading to a depth of 3 to 6 inches, depending on the soil type, may be employed. Hand raking is used to smooth and pulverize the soil sufficiently to make it suitable for planting.
- (6) Fertilizing requirements of grasses vary in relation to nutrient content contained in a particular soil. Whenever possible, soil tests first are made through use of local sources. Soil-test interpretation for camouflage purposes is concerned primarily with cover and color and not necessarily with productivity of crops planted. The following basic practices will be considered only as a guide:
- (a) *Proportions of constituents.* Fertilizer mixtures containing approximately half as much phosphoric acid

as nitrogen and still less potash give excellent results in most climatic and soil conditions.

- (b) *Variations in proportions.* Inorganic fertilizers of 10-6-4 and similar proportions should be applied at the rate of not less than 400 pounds to the acre. The content of commercial fertilizers is designated by numbers which indicate the percentage of their nutrients: 10-6-4 means ten percent nitrogen, six percent phosphoric acid and four percent potash. If fertilizers with different percentages of nitrogen are used, the rate should be modified so that corresponding amounts of nitrogen are applied. On areas such as roadsides or shoulders of runways, where fertility is extremely low, it is advisable to apply two or even three times this amount during the preparation of the original seedbed. When phosphorus or potassium is lacking, apply larger amounts of phosphoric acid and potash than are present in a 10-6-4 fertilizer.
- (c) *Fertilizing as maintenance.* After turf has become established it usually will be necessary to apply fertilizer occasionally to maintain a heavy stand. The frequency and rate of application depend on the fertility of the soil and the quality of turf required. It is not safe to apply inorganic fertilizers at rates heavier than 40 pounds of nitrogen to the acre (400 pounds of 10-6-4 or 200 pounds of sulfate of ammonia) because of the danger of burning the foliage. Also, to avoid serious burning of the grass, apply only when the blades of grass are dry. Do not apply inorganic fertilizers to young seedling grass.
- (d) *Seasons for application.* Inorganic fertilizers are applied to turf just prior to the time of most rapid growth of the grass. In cool humid regions, applications in late summer or early autumn encourage maximum growth of the turf grasses after the annual grasses and weeds have been killed by the first light frosts. In these regions, fertilizer applications, if made in the spring, should be made very early. In warm humid regions, summer-growing grasses are fertilized in the spring to encourage the spring and summer growth. On light sandy soils in either region, where the nutrients in inorganic fertilizers leach rapidly, make several small applications during the growing season rather than one large application.

- (e) *Organic and inorganic fertilizers compared.* For most conditions inorganic mixtures are more satisfactory than organic ones from the standpoint of cost as well as quick reaction on grass growth. Where large local supplies of organic waste materials, such as activated sludge, are available, take advantage of such materials; but it should be remembered that while their effect may be more lasting than is that of inorganic mixtures, the response of the grass will not be as quick. The chemical analysis of such materials should be determined, and they should be applied at rates which furnish at least 40 pounds of nitrogen to an acre.
- (f) *Lime.* Finely ground limestone is commonly used on highly acid soils. Unless soil is very strongly acid, the rate need not exceed $\frac{1}{2}$ to 1 ton per acre. If hydrated lime is used, do not apply it within 2 weeks of the time of application of fertilizers containing ammonium salts.
- (7) Planting grass is accomplished by planting grass seed, planting fragments of actively growing grass, called sprigging, or by transplanting grass sod. Sodding and sprigging are the quickest methods of obtaining a tough wear-resisting turf.
- (a) Good seeding depends on even distribution of seed, depth of planting, and rate and time of seeding.
1. Broadcast seeding is done by hand or by mechanical seeders. Even distribution is accomplished by sowing half of the seed over the entire area in one direction and the remaining half crosswise to it. A rake, drag, or harrow covers the seeds to the desired depth.
 2. Drill seeding is limited to the availability of drill equipment (fig. 53). Some drills have the advantage of distributing seed and fertilizing in the same operation.
- (b) Sprigs are fragments of grass producing runners either above or below the ground. Each runner will produce roots when covered with soil and provided with adequate moisture. Only grasses producing such runners are used for sprig planting. Sprigs must be kept moist and be covered immediately after planting to prevent drying out. Such factors as the availability of sprigging material and equipment, the availability of labor forces, the size of the area to be planted, and

the time requirement for completion of the task will determine which of the three sprigging methods discussed below should be used.

1. Spot-sprigging is the planting of sprigs at regular intervals in rows. This requires the least material, but takes the longest period of time for a dense cover turf.
 2. Row-sprigging is the placing of sprigs in furrows and covering with a plow, drag, or hand rake, or by forcing the sprigs into the ground by hand. Effective sprig-planting machines have been developed by the Corps of Engineers. This method uses more planting material than spot-sprigging but requires less time to produce adequate cover.
 3. Broadcast-sprigging is the distribution of sprigs over an area by hand or machinery. In small areas, the sprigs are scattered by hand, rolled, and then covered by a thin top dressing of soil. In large areas, sprigs may be distributed by a manure spreader or woodchip spreader.
- (c) Thin sod is easier to move than thick sod. Thin sod, cut in 1-inch or even $\frac{3}{4}$ -inch depths, has more surface roots exposed and therefore becomes anchored more quickly but dries out very rapidly. Thin sod should not be used unless plenty of moisture is assured either by rainfall or through available water facilities. Sod cut in 2- to 4-inch depths will not dry out as quickly, but requires more labor to move and a longer time to become anchored.
1. Spot sodding is the planting of small blocks of sod at regular intervals. This method can be used when the grasses are of a rapidly spreading species. It is employed chiefly in areas subject to periods of drought.
 2. Solid sodding is the complete covering of an area by strips of blocks of sod. This method requires the most material and the largest amount of labor.
 3. Strip sodding is employed successfully in many cases on slopes which are too steep for the use of other planting methods (fig. 54). Spaces between strips may be seeded or sprigged.

f. Mowing. Mowing produces effective changes in the color and texture of grassed areas (fig. 55). Mowing is especially suitable for the camouflage of any area. Differences in tonal values are marked during periods of maximum growth, but during dor-

mant seasons differences between mowed areas, varying from 2 to 6 inches, are not apparent at distances of more than 1 or 2 miles and at altitudes above 2,000 feet. To maintain a distinct difference at all seasons, turf in certain areas is allowed to mature without mowing, while other areas are regularly mowed at heights of 3 to 6 inches. Careful and regular maintenance is essential. A few of the more common effects obtainable are described below:

- (1) Ditches can be simulated by mowing or hand cutting tall grass in lanes from 4 to 6 feet wide (fig. 56). The difference in texture between the mowed and the unmowed portions, and the resulting cast shadow, produce the effect of ditches to the air observer.
- (2) Simulation of field cultivation is obtained by mowing adjacent areas in various directions and at different heights.
- (3) Four or more pattern changes can be accomplished by combining fertilizing with varying heights of cut. Grass mowed at 2 to 3 inches may be fertilized to produce one pattern, while an unfertilized portion of the same cut will produce a pattern of different texture and color. Grass mowed at 5 to 6 inches will produce a coarser texture and a darker ground color than low mowing.

22. Two-Dimensional Ground Patterning Using Fertilizers and Chemicals

a. Fertilizing. The application of fertilizer to turf produces increased growth, greater density, and thereby a darker tone. By regulated fertilization of the different areas of a field, several ground colors and textures are produced (fig. 57). Fertilizing for this type of ground patterning is most effective in the spring or autumn seasons.

- (1) The effects possible by using controlled fertilizing are most deceptive at low altitudes. At high altitudes and oblique angles the patterns are less noticeable and may be lost entirely.
 - (a) Hedgerows are simulated by applying fertilizer in irregular strips; when applied in curves the contours of rolling terrain may be simulated.
 - (b) Row crops are simulated with the use of fertilizer drills (farming equipment) by closing some of the regular spaced openings in the drill.
 - (c) Ripened grain or other brown vegetation can be simulated by applying fertilizers in excess or during unfavorable seasons as when the weather is hot and humid, or the grasses are wet. These are temporary burns and do not destroy soil or vegetation.

- (d) When seen at favorable angles from the air, orchard plantings can be simulated by uniform application of high-nitrogen fertilizers to regularly spaced circular spots arranged either in straight rows or along false contour lines to suggest hilly terrain.
- (2) Recommended fertilizers are—
 - (a) Sulphate of ammonia and nitrate of soda, or prepared fertilizers containing them for quick stimulants.
 - (b) High-nitrogen fertilizers.
 - (c) Use above fertilizers at a rate which provides approximately 40 pounds of nitrogen to the acre. Increase this rate on very poor soils to give the desired result.
 - (d) These same fertilizers are useful in causing burns, and subsequent browning, by excessive applications. Burns may also be produced by spraying the turf with 1 to 5 pounds of sulfate of ammonia per 1,000 square feet. The heavier rates of application are needed in cool dry weather. In hot humid weather maximum burning is effected and rates of application must be kept at the minimum to avoid permanent damage to turf. In case spraying equipment is not available, maximum burning of grass is accomplished by spreading fertilizers on grass when it is wet with dew.

b. Chemicals. Chemical killing agents produce a peculiar burning and discoloration on turf, which provides another but somewhat limited method of ground patterning (fig. 58). The injury to the turf is only temporary, but must be carefully controlled by varying the rate of application according to season, soil conditions, and type of vegetation.

- (1) Suggested uses of killing agents are—
 - (a) Spraying one or more sections of a turf airfield with one or more chemical killing agents to produce areas of different colors, giving the appearance of separate fields.
 - (b) Simulating row crops at the appropriate season by closing some of the openings on a boom sprayer to give proper spacing.
 - (c) Spraying strips or bands of turf 75 to 100 feet wide in curved lines to conform to contour lines in the vicinity; this makes a level surface appear to be a hill or a gully.
- (2) Notes on the use of killing agents:
 - (a) Spraying, using issue or commercial agriculture equipment, produces best results.
 - (b) In burning vegetation with killing agents, the solution

should be as concentrated as possible. The most severe burns are made during hot humid weather, so rates of application can be lower at such times. This accomplishes a maximum of burning with the smallest amount of water.

- (c) Some chemicals are extremely poisonous internally and externally and should be applied with caution.
- (3) Types of chemical killing agents, their application, and their coloring properties follow :
 - (a) Sodium arsenite and other arsenicals produce a straw color, which closely resembles ripe grain and similar grasses. They may be used at rates of 10 to 40 pounds to the acre. This killing agent is extremely poisonous and should be carefully handled.
 - (b) Iron sulfate blackens grass and has possibilities for creating shadow patterns on turf. From 50 to 250 pounds are applied per acre.
 - (c) Ammonium thiocyanate has a bleaching effect on turf, lasting from several days to a month or more. It must be noted that the nitrogen it contains then becomes available and stimulates the grass to produce a darker, more vigorous growth. From 50 to 250 pounds are applied per acre, depending on growth and weather conditions.
 - (d) Aniline dyes have been used on turf to produce a dark green color. A common mixture contains approximately % malachite green and % auramine, with a trace of crystal violet.



Figure 52. A decoy runway being burnt over.

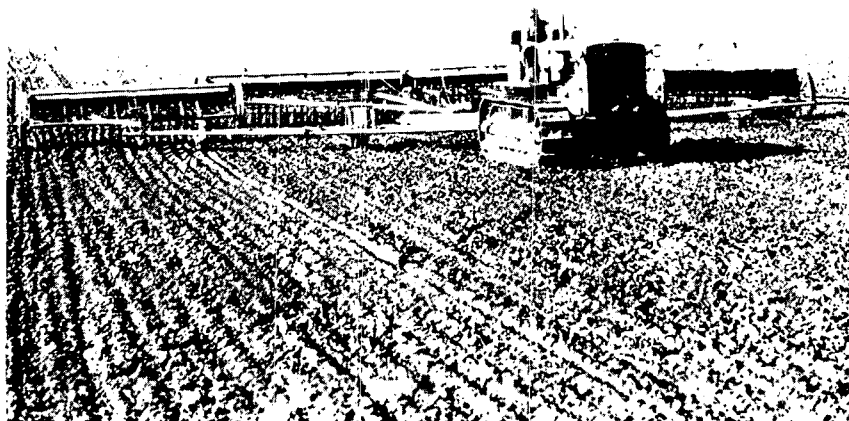


Figure 53. Drill seeding a section of an airfield site for ground patterning.

- (e) Ammonium the arsenite and ammonium sulfate also may be used for this purpose.
- (4) Since spraying equipment varies, each machine should be calibrated by spraying a measured amount of water on turf. Sufficient water should be applied to cover the foliage thoroughly without dripping. The requirement per acre for each type of spray outfit can be determined



Figure 54. Strip sodding of a revetment in camouflaging an airfield installation with native labor.

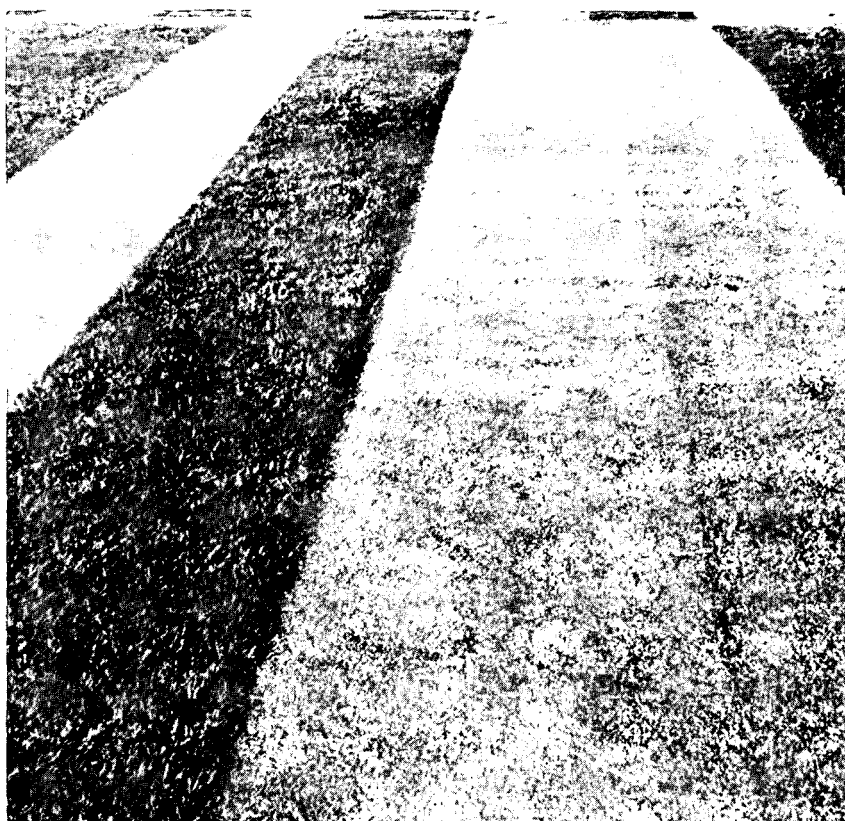


Figure 55. Ground patterning by controlled mowing.



Figure 56. Simulated ditch by cutting a lane through high grass.

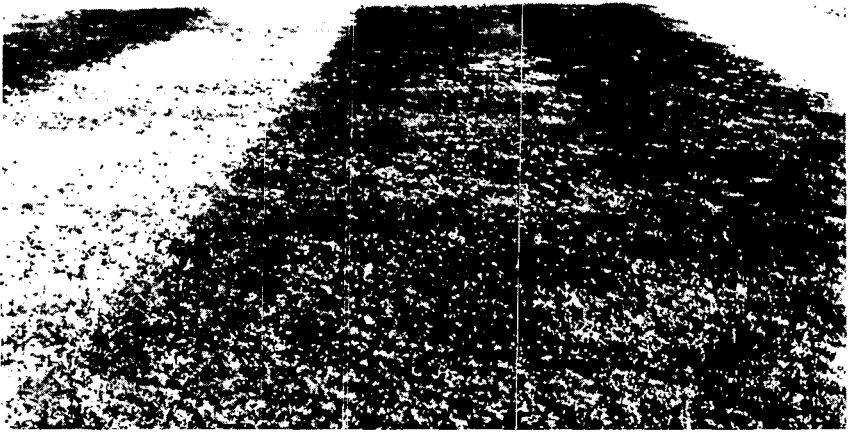


Figure 57. Ground coloring by fertilizing.

by measuring the area covered and the amount of water necessary. The amount of killing agent required for the area to be sprayed then can be dissolved in the amount of water needed.



Figure 58. Ground patterning by use of chemical killing agents.

23. Three-Dimensional Patterning

a. *General.* Three-dimensional patterning involves height and thus stronger contrasts in color and texture must be provided. To effect this, coloring, texturing, and structural materials are used. Buildings and other three-dimensional forms or installations are the objects to be patterned. Techniques include the extension of adjacent ground patterns over roofs or other horizontal surfaces. Vertical surfaces are similarly treated.

b. *Roof Patterning.* Figure 59 illustrates disruptive patterning of roofs by means of painting and the application of texturing to render them nonsuspect. In figure 60 the roof of an airfield structure has been painted to simulate the ground pattern of the adjacent orchard. Note that in the picture the shadows of the building have not been concealed. Screens attached to the edge of the roof, sloping gradually to the ground and garnished with real or artificial foliage in the orchard pattern, would eliminate this telltale shadow.

c. *Ground Pattern Painting in Perspective.* The simulation of



Figure 59. Roof patterning with paint and texturing materials to render buildings non-suspect.



Figure 60. Roof patterning to blend airfield structure into the background.

an aerial view of a residential area (fig. 61) can be painted on a runway for concealment.

d. Trees as Patterning Material. Artificial trees are constructed easily from garnished wire screens, suitably supported, or from other suitable materials (fig. 62). These, or live trees, may be sited or transplanted in an orchard pattern to aid in the concealment of airfield or other installations (fig. 63; and see foreground of fig. 3).

e. Patterning of Horizontal and Vertical Surfaces. Patterning with paint and the application of artificial and live shrubbery to conceal a small building are shown in figure 64.

f. Structural Materials for Changing Patterns. The straight lines of buildings and structures can be disrupted by covering with plywood or similar material cut in patterns to duplicate background. As indicated in figure 65, a building may be blended into the background pattern with the application of structural material to disrupt straight lines, painting patterns, and texturing materials.



Figure 61. Aerial view of a residential area on a runway in which shadow, shape, and tone have been used to simulate three-dimensional quality.

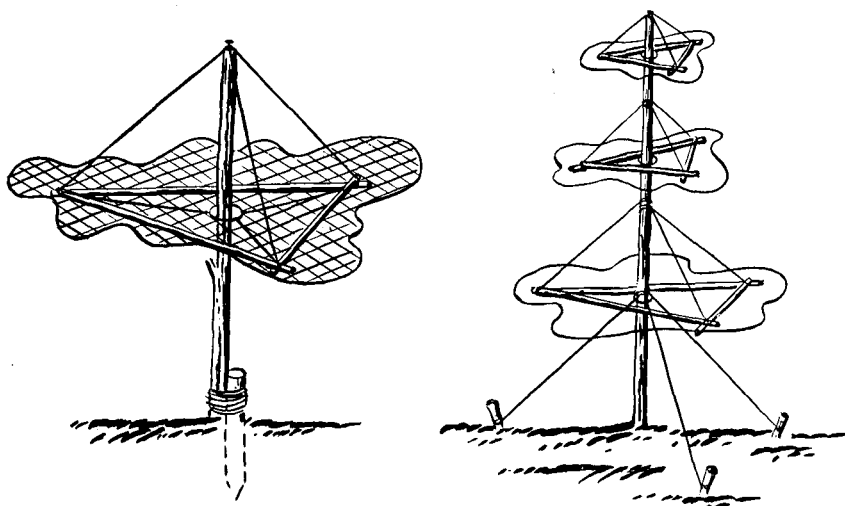


Figure 62. Use of artificial trees.



Figure 63. Artificial trees in three-dimensional orchard pattern.



① WITHOUT CAMOUFLAGE

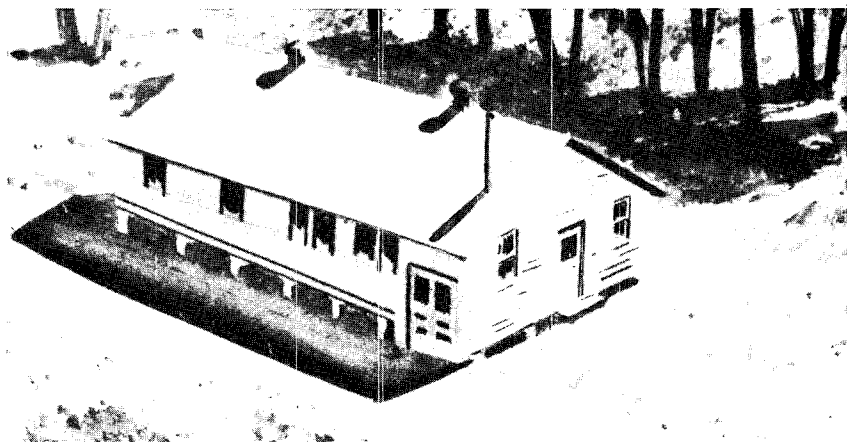


② PATTERNING WITH PAINT

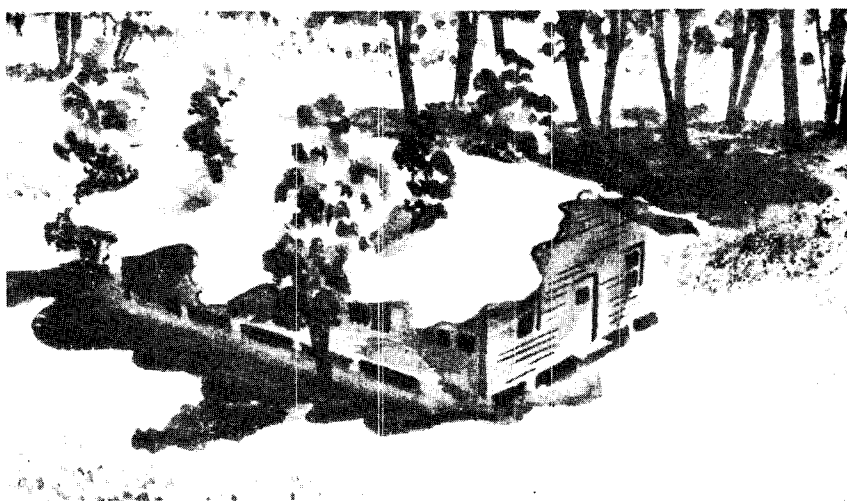


③ PATTERNING WITH PAINT
AND ARTIFICIAL SHRUBBERY

Figure 64. Patterning of horizontal and vertical surfaces for concealment of building.



① WITHOUT CAMOUFLAGE



② EXAMPLE OF PROPER APPLICATION
OF ALL 3 ELEMENTS

Figure 65. Changing roof pattern with structural material, coloring, and texturing.

CHAPTER 4

TEXTURING AND GARNISHING MATERIALS

Section I. GARNISHING MATERIALS

24. General

The application of texturing materials to small areas, nets, netting, and screens is called *garnishing* and the materials applied are *garnishing materials*. Many texturing and garnishing materials are issued and many more, both natural and artificial, may be used as field expedients. Table XXVI lists the more common materials used.

25. Garnishing With Fabric

a. Production of Fabric Garnishing Strips. Cloth garnishing strips are an item of issue. Field-factory methods for coloring and producing cloth garnishing strips are described in paragraphs 16 and 17 and illustrated in figures 43 and 67.

b. Fabric Garnishing on Camouflage Nets. Nets and nettings are issued both garnished with fabric strips and ungarnished. An example of netting issued with fabric garnishing is shown in figure 66. In this case the netting used consists of plain chicken wire.

c. Field Methods for Garnishing Twine Nets. If pregarnished netting is not available, the following expedient mass production method using issue twine netting as a frame has proven successful.

- (1) Construct a framework table, 15 by 15 feet square, with four bays. Larger tables are not recommended because of the great amount of lumber and space required. Larger nets can be garnished by moving them about on the table as required. The patterns used for the weaving of garnishing strips into the net, and a design section of garnished net, are shown in figure 68. A photographic closeup of an actual segment of a garnished twine net is shown in figures 66 and 72. For a discussion of garnishing patterns and techniques see *d* below.



Figure 66. Fabric garnishing on issue wire netting.

- (a) Place twine net on the table. Garnish from the center outward, thinning according to specifications determined by the end use of the garnished net (par. 8b). This is accomplished by entering the bays and moving out of them as garnishing progresses toward the sides.
 - (b) Place supplies of colored garnishing strips within easy reach of personnel.
 - (c) Garnished nets can be folded at the tables or removed to other areas for folding.
- (2) Another method of mass production employs a garnishing frame approximately 48 feet long and about shoulder high (fig. 69). Fourteen men can work conveniently on the frame—seven to a side.
 - (3) It can be estimated that with troop labor approximately 200 square feet of garnishing will be produced per man in an 8-hour day. Over an extended period, an average of 25.6 square feet of garnishing per man-hour has been realized. The maximum production for a single day was

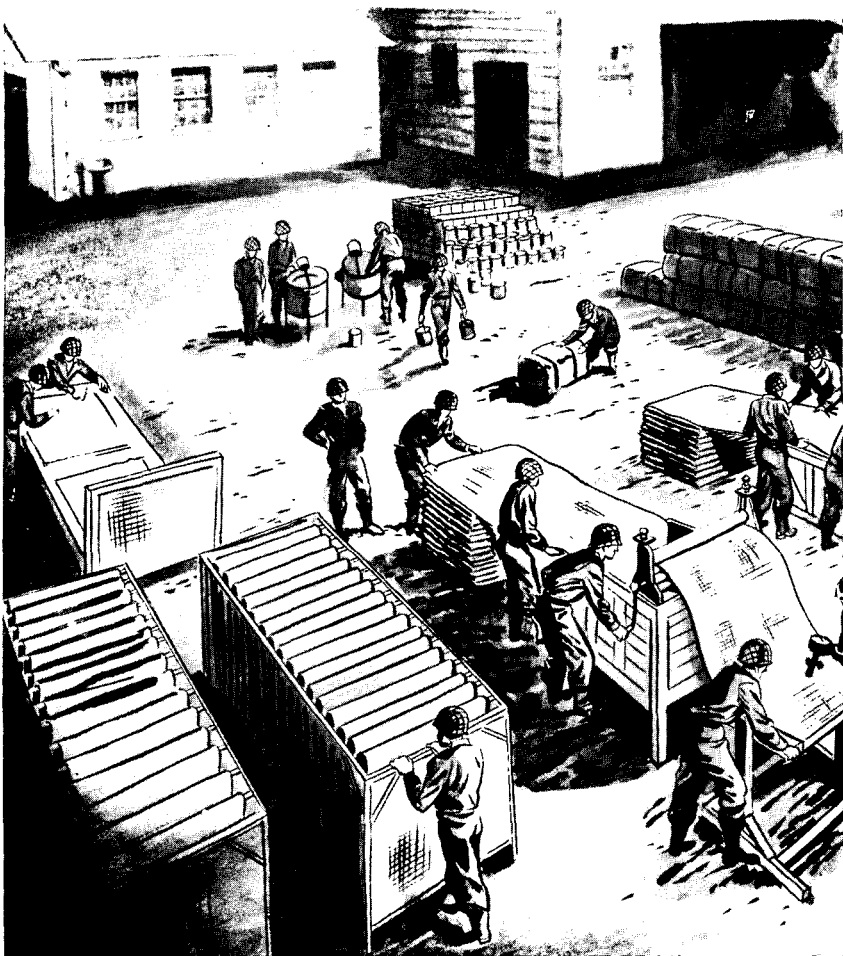
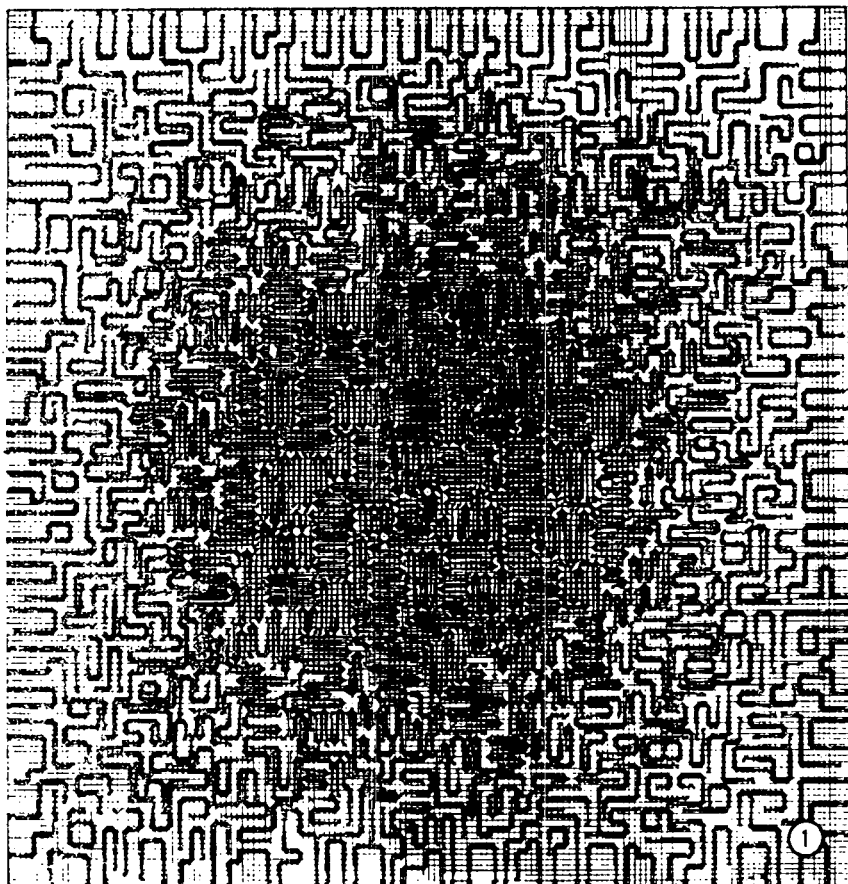


Figure 67. Field-plant for the production of colored garnishing strips.

26.6 square feet per man-hour. Approximately 1,200 garnishing strips are required to garnish 1,000 square feet of net with 100 percent coverage.

- (4) Spray-painting garnished nets is occasionally necessary. Use of a 35-foot boom to hang the nets while painting with a sprayer—has been highly successful in the field (fig. 70). A detail of three men is employed, one on the

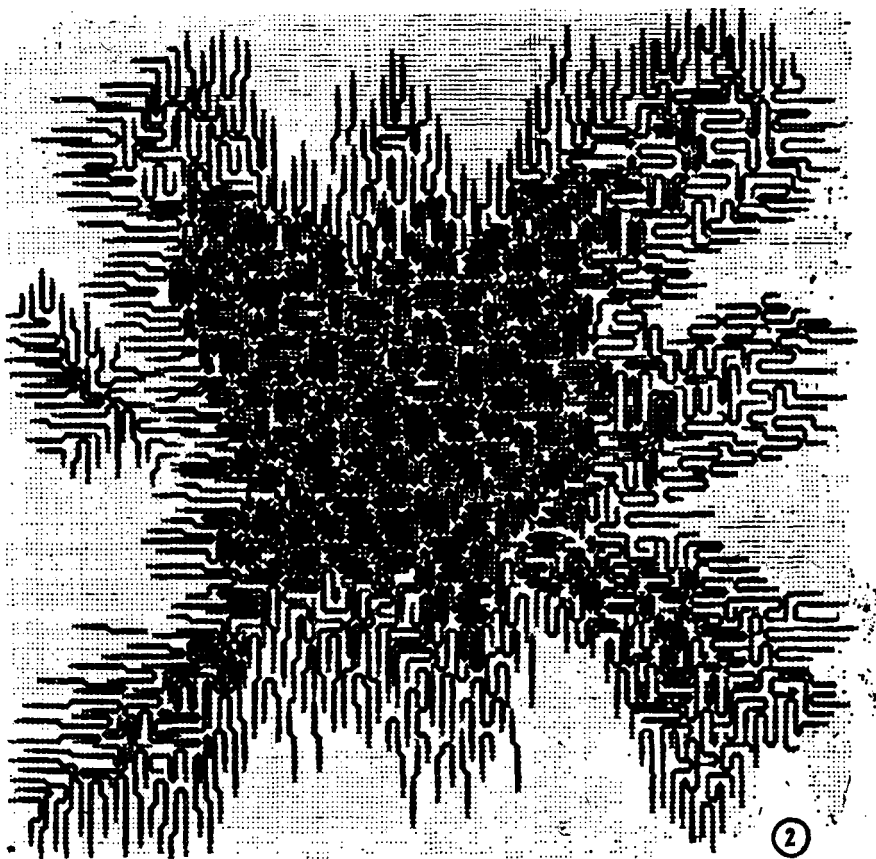


1 Vehicle drape pattern.

Figure 68. Sample patterns for garnishing twine nets.

motor and two alternating on the spray gun. Goggles and respirators are worn because fine paint vapor is injurious to lungs and eyes.

d. *Garnishing Patterns, Color Blends, and Techniques.* There are two basic patterns for the garnishing of twine nets—the drape pattern and flat-top pattern. A brief description of the screening value of each type is found in paragraph 8b. A schematic diagram of each pattern is shown in 2 and 3, figure 68. Once the pattern to be used has been determined, table XXIX should be consulted for the number of 2-inch by 5-foot garnishing strips required for a particular sized net. At this point, the color blend of the net to be garnished should be decided, and the percentage



2 Flat-top pattern.

Figure 68—Continued.

of the total number of strips of each color required should be obtained according to the following formula:

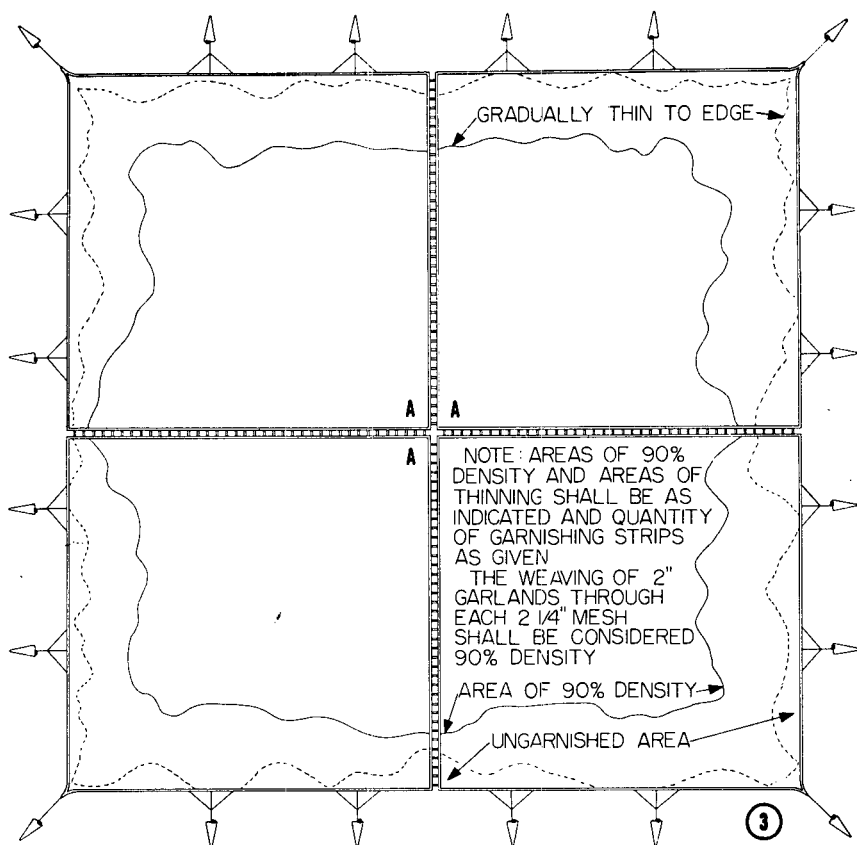
Tropical and summer temperate: 70% dark green, 15% field drab, and 15% light green.

Winter temperate: 60% earth brown, 10% earth red, and 30% olive drab.

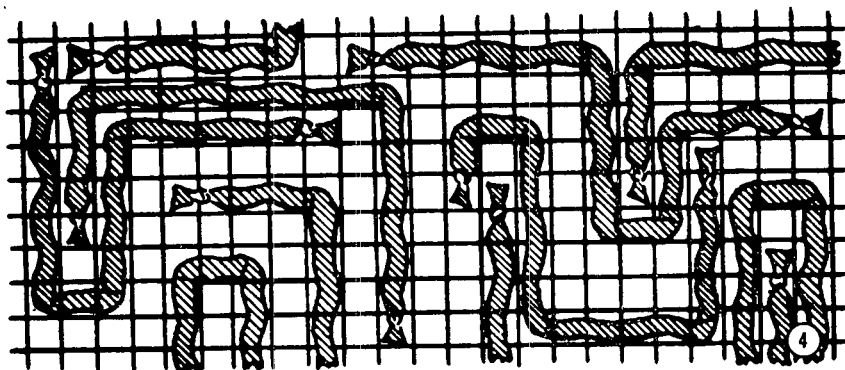
Desert or arid area: 80% sand, 10% olive drab, and 10% light green.

All-seasonal: 60% dark green, and 40% earth brown.

The overall color blend of a net is achieved by indiscriminately mixing the garnishing strips of the various colors required for any one blend, and placing the strips in the net at random as an overall even mixture of colors. Long straight runs, large areas,

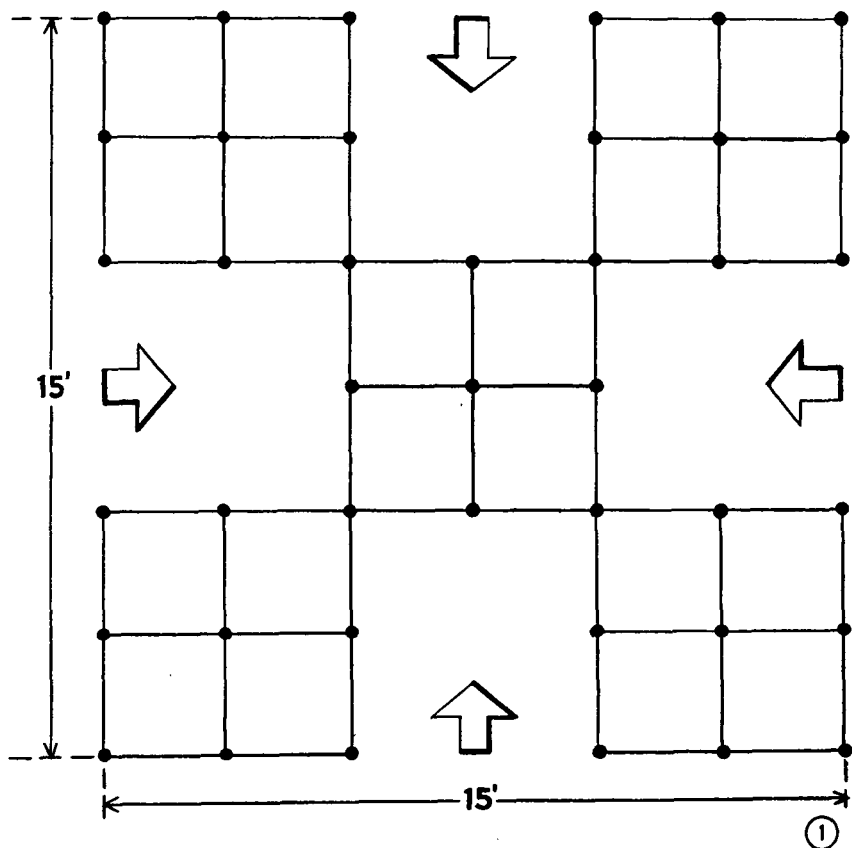


3 Overall drape set pattern (4 nets).



4 Detail of garnished net.

Figure 68—Continued.

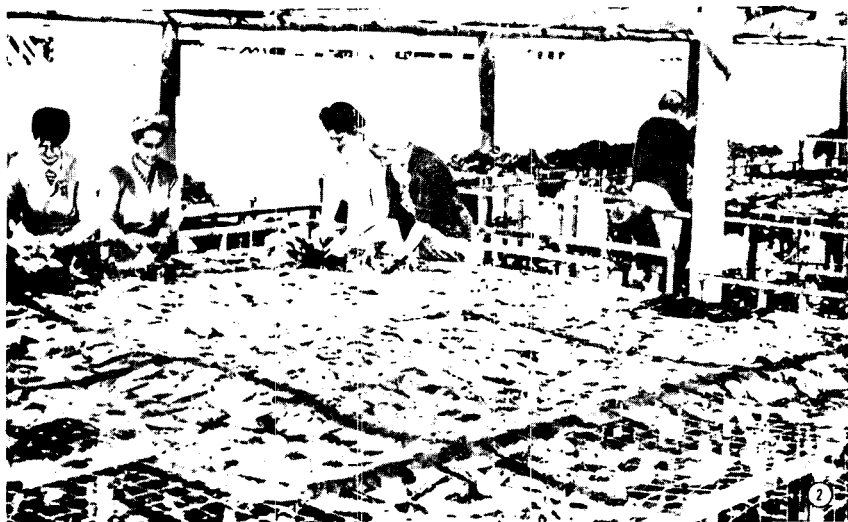


1 Diagram of table layout.

Figure 69. Layout for garnishing twine nets, factory method.

or blocks of one color, or regularity of color pattern in a net, should be avoided.

e. Detailed Technique for Garnishing (4, fig. 68). The 2-inch by 5-foot colored fabric strips are garnished in the net by inserting each strip alternately over and under the mesh of the net. Each strip should be kept flat, and should cover from 18 to 20 meshes of a $2\frac{1}{4}$ -inch mesh net. The ends of each strip should be secured to the net by an overhand knot tied tightly, with a $1\frac{1}{2}$ -to 3-inch free end projecting from the knot. These free ends must not be trimmed or cut off. No knots should be tied to the taped edge of a net, nor tied to the edge of an embrasure slit should the net have one. Neither should garnishing strips be tied or woven across such a slit. The strips when garnished and knotted in the net should not be drawn tight, but should be sufficiently loose and contain enough slack to prevent distortion



2 Civilian employees garnishing twine nets.

Figure 69—Continued.



Figure 70. Troops garnishing twine nets.

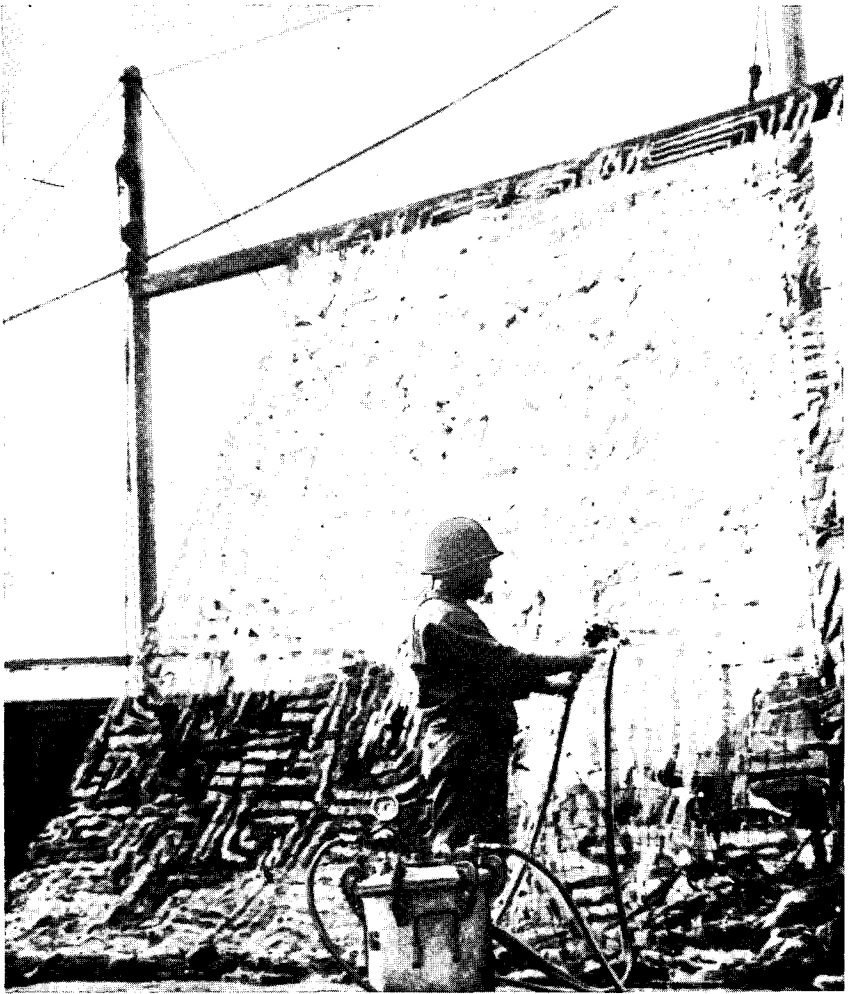


Figure 71. Spray-painting garnished twine net.

of the meshes of the net, and to allow the net itself to take all the strain when it is erected. Strips should not cross over one another, nor should any mesh contain a portion of each of two strips. All turns should be made at right angles, and not diagonally through the meshes. Garnishing strips around the outer edge of the net should terminate at right angles to the net edge as shown in 1 and 2, figure 68. When garnishing nets for use in sets where two or more nets are combined to form a single cover, the combination must be considered as one unit and garnished to a single pattern accordingly.

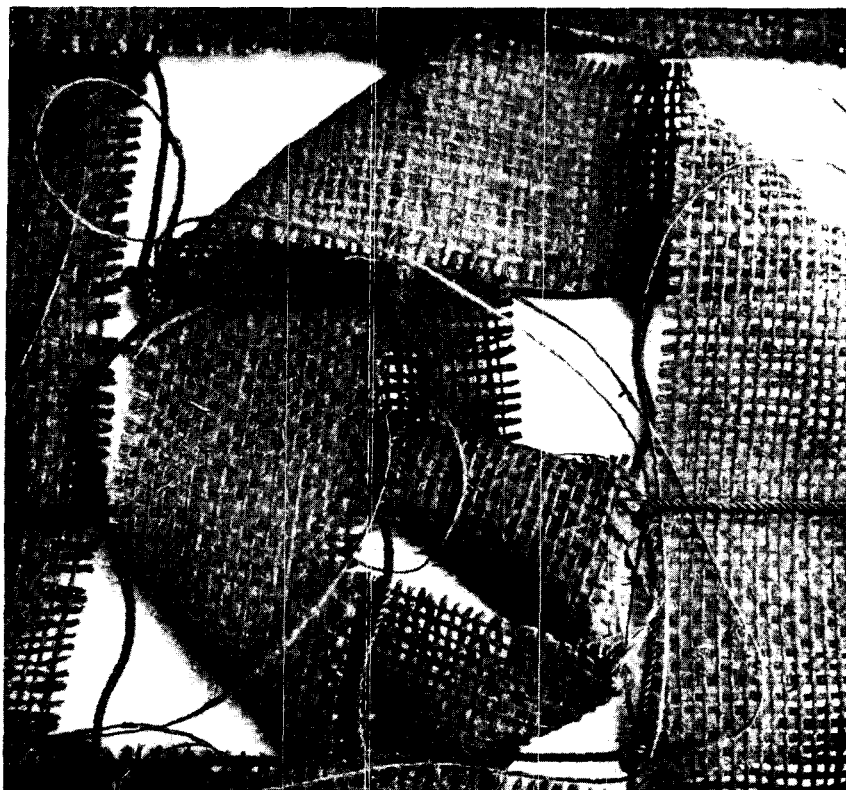


Figure 72. Closeup of twine netting garnished with burlap strips.

26. Garnishing With Feathers

a. General. Feathers have been extensively employed and have proved most useful. Sources for feathers are—poultry slaughter houses, mattress and pillow factories, and upholstering plants. In remote areas the natives may be able to provide limited quantities. It is probable that feather-garnished chicken wire may be issued as a substitute for steelwool garnished netting during field operations. Feathers procured as a garnishing material must be clean, dry, and free from disease germs and insects. Crushed feathers are acceptable provided not more than 5 percent by weight consist of down separated from the spine. For large-scale coverage, tail and wing feathers are acceptable provided they are crushed in such a manner that sections of the spine do not exceed 3 inches in length. In the field, however, long feathers can be used, in many cases, quite effectively. Depending upon density requirements, the coverage may vary from 7 to 13 square yards per pound of feathers.

b. Field-Expedient Machine. Feathers usually are affixed to

wire netting. A machine has been devised to perform the whole operation in a continuous belt system (figs. 73-75). A roll of wire is placed at one end, with an axle through the central hole of the roll. The free end of the wire passes under a guide in the bottom of a trough filled with an adhesive, such as bituminous emulsion, and continues under a hopper filled with feathers. The hopper has an agitator at the lower end, which keeps the feathers flowing freely. The feathers fall onto the wire. Two men, one on either side, manipulate a board to spread the feathers over the wire evenly. The wire then passes under a roller to press the feathers to stick them onto the adhesive-coated wire. The garnished wire is then rerolled at the other end. If such equipment is not available, the wire is dipped in a trough of adhesive and the feathers spread by hand. After drying overnight, the garnished wire is painted.

c. Garnishing Twine Nets. When feathers are applied to twine nets, the nets are dipped into a G.I. can filled two-thirds with bituminous-emulsion adhesive. To obtain irregularly garnished edges, the net is held by all four corners in dipping. Only the center of the net thus receives a heavy application of adhesive. The feathers are distributed by hand. The net is rolled and left to dry for two days. After excess feathers are shaken off, the prepared netting is spray-painted if required (par. *d* below).

d. Uses of Feathers.

- (1) Some feathers can be used without further treatment in areas where their color fits the color of the ground. For example: Plymouth Rock hens, duck and goose feathers match gray granite; turkey feathers match slate-colored rock; Rhode Island Red hen feathers match reddish earth; white feathers match light earth, but appear darker than snow. Otherwise, artificial coloring is normally accomplished by spraying.
- (2) The recommended uses of feathers for garnishing are: on chicken wire for permanent flat-tops, simulated trees, (fig. 62), simulated rock forms (fig. 106), twine nets, and walls.
- (3) The durability of feather garnishing is good. It offers less resistance to wind than nets garnished with other materials, allows dry snow to sift through the meshes, and is fire retardant.
- (4) When feather-garnished wire netting is used on flat-tops and drapes, the best procedure is to lay out on the ground the required number of garnished stripes of chicken wire and wire together the adjacent sides. The whole then is painted, thus avoiding the striped effect which would

result from painting each strip individually. The garnishing at the edge of the netting must be thinned or extensions of the netting at the sides must be sloped to the ground to avoid telltale shadows.

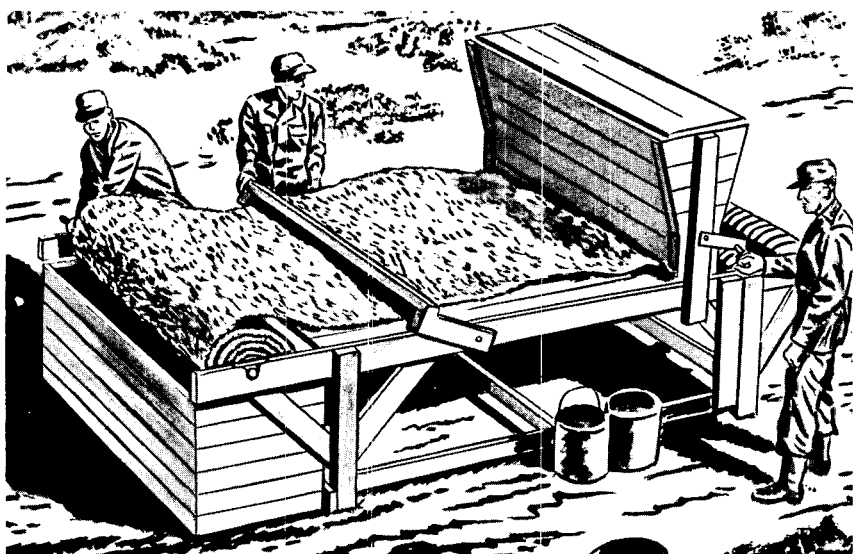


Figure 73. Feather-garnishing machine in operation.

27. Garnishing With Metal

a. Steel Wool. This loosely matted, finely-spun material is particularly useful where a fireproof garnish is required. It has excellent textural quality. It comes prefabricated, bonderized to retard rusting, precolored, and attached to rolls of welded, rectangular meshed wire. It requires large amounts of paint to recolor. Figure 76 shows a closeup of a steel-wool-garnished wire screen.

b. Tin Cans. Used tin cans, when mashed or cut into strips and splayed out (fig. 77), are a readily available and practical garnishing material of excellent textural quality (fig. 78). The can most widely used in the Army is the No. 10 can (diameter $6\frac{1}{8}$ inches, height 7 inches). One can is required to garnish each 1 to 2 square feet of surface. Tin-can garnishing can be employed to add texture to large areas of cloth-garnished overhead nets (fig. 79). A procedure for preparing tin-can garnishing follows:

- (1) After collecting a suitable number of cans, cut sides into strips approximately 1 inch wide to within 1 inch of the bottom of the can. For construction of a field-expedient

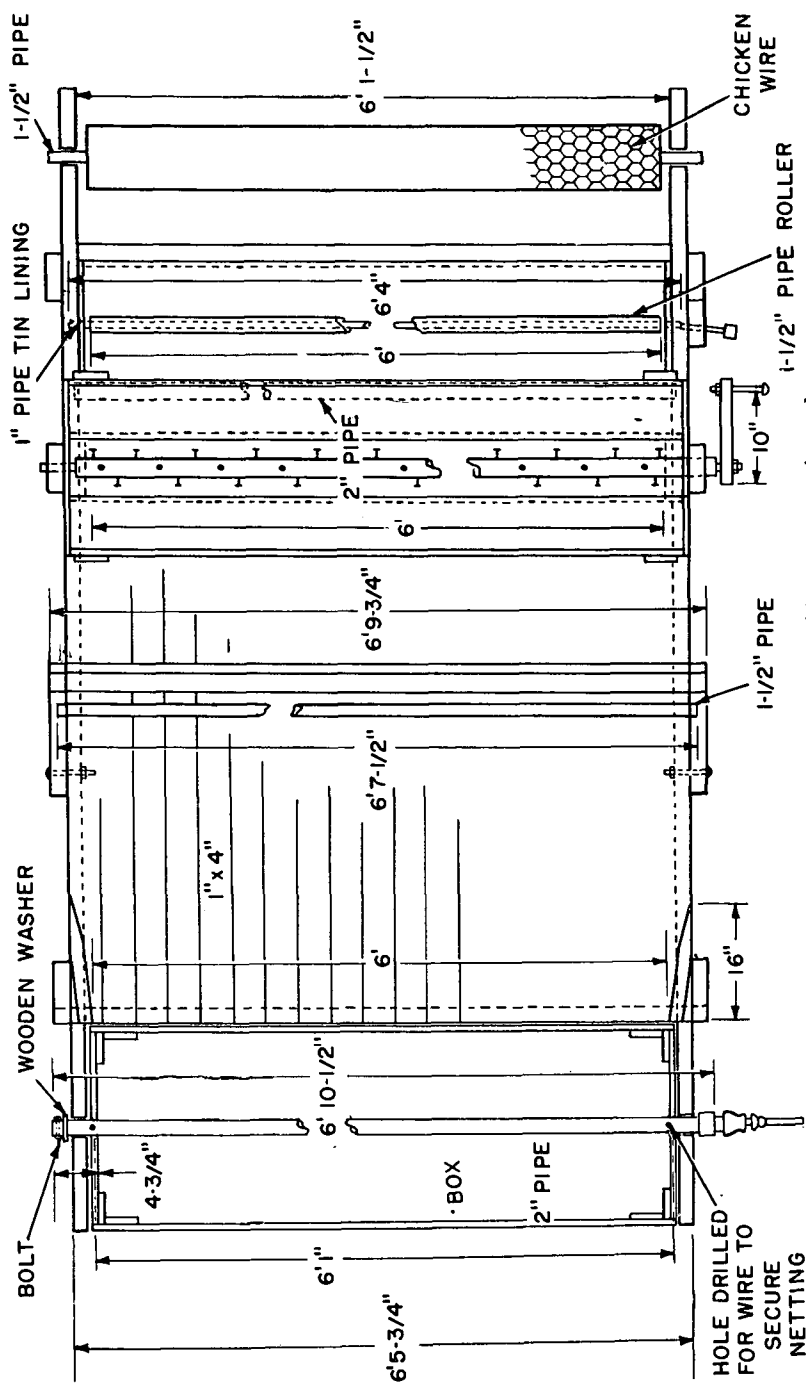


Figure 74. Feather-garnishing machine construction, plan.

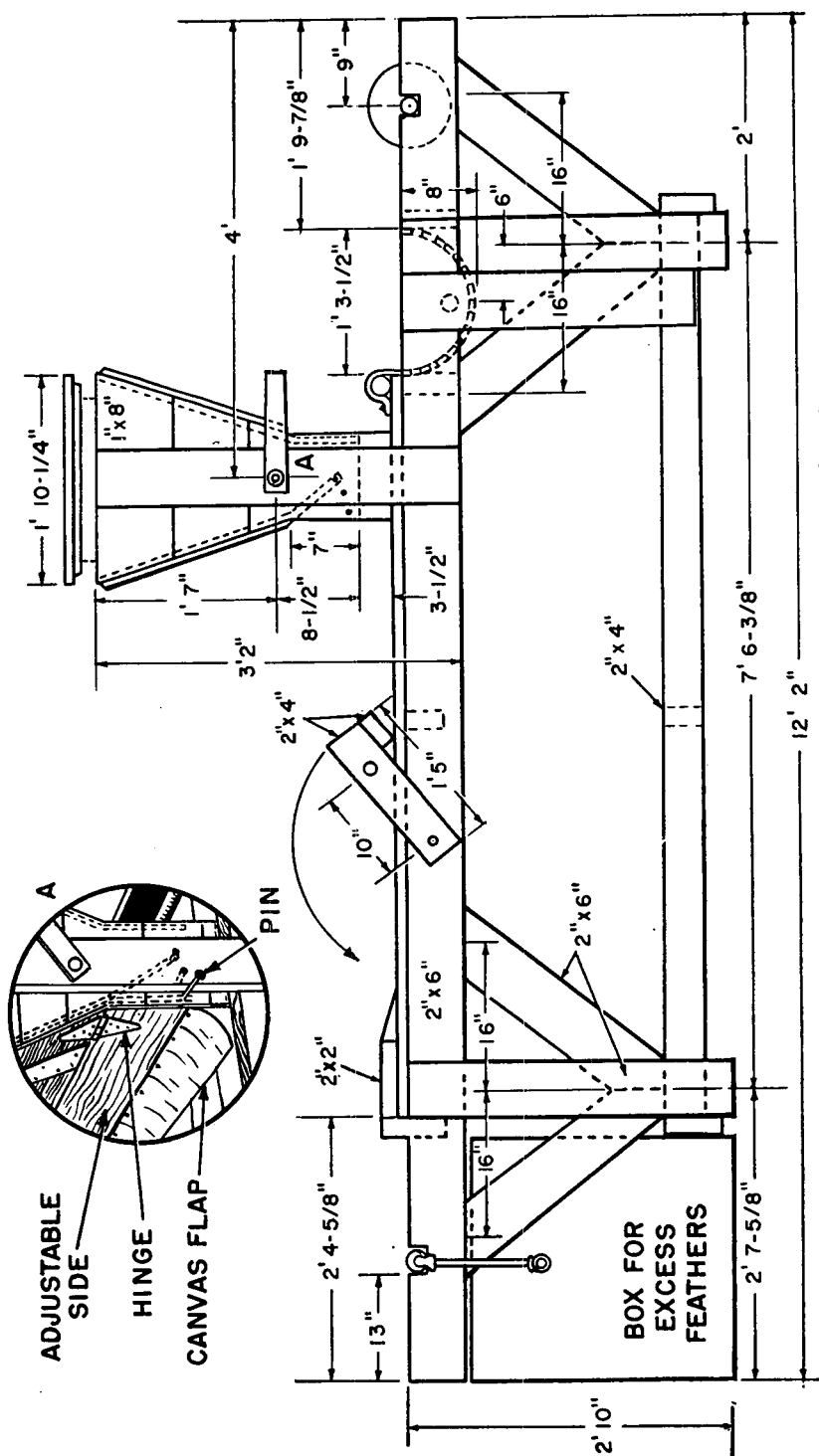


Figure 75. Feather-garnishing machine construction, elevation.

cutter, see figure 80. Construction material includes: 3-inch angle iron, one piece of steel and a few bolts. Angle iron A is fastened to wood block on tree stump at three points B, C, D. Blade is made of spring steel and fastened to angle iron by bolt and spring E. In operating cutter, slip No. 10 can over end of angle iron as shown and cut into strips, holding and rotating can as each cut is made.

- (2) Place cans in a fire to remove the light-reflecting lacquer and to provide a rough surface on which to paint.
- (3) (Optional). Fabric strips may be crimped to the ends of the tin strips.
- (4) The tin strips are bent, some in, some out, to produce an irregular form.
- (5) (Optional). Paint, if required, by dipping, brushing, or spraying. The rust color of the cans blends with some backgrounds without painting.
- (6) (a) Attach to chicken wire by clinching two or three of the strips around the mesh or
(b) Nail the can to a flat wooden surface or
(c) Run a wire through holes punched in the bottom of the cans and suspend from an overhead crosswork of single wires. When strung in this fashion in quantity, the tin-can cover acts as a screen, and the shadows of the cans also help to disrupt the form of equipment placed under such an overhead cover.



Figure 76. Wire screen garnished with steel wool, closeup.

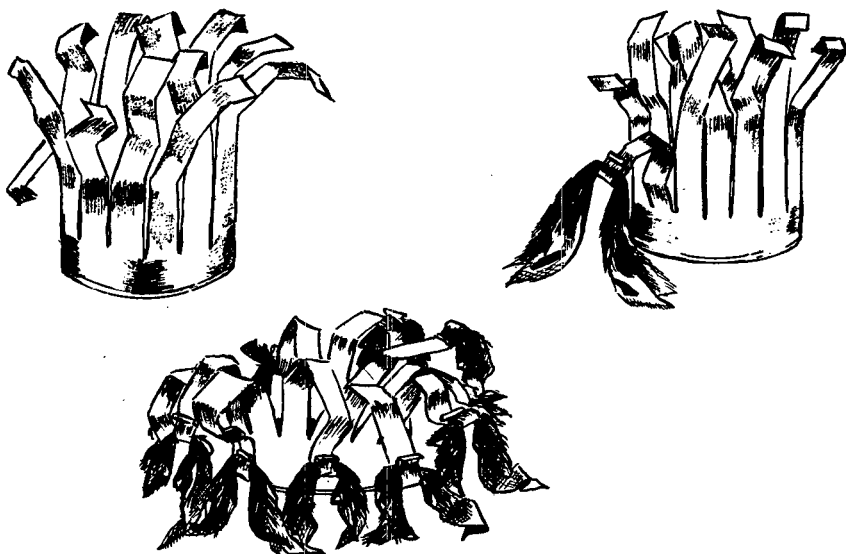


Figure 77. Used tin cans prepared for garnishing.



Figure 78. Detail of tin-can garnish applied to a roof.



Figure 79. Tin-can garnishing added to garnished overhead wire screen.

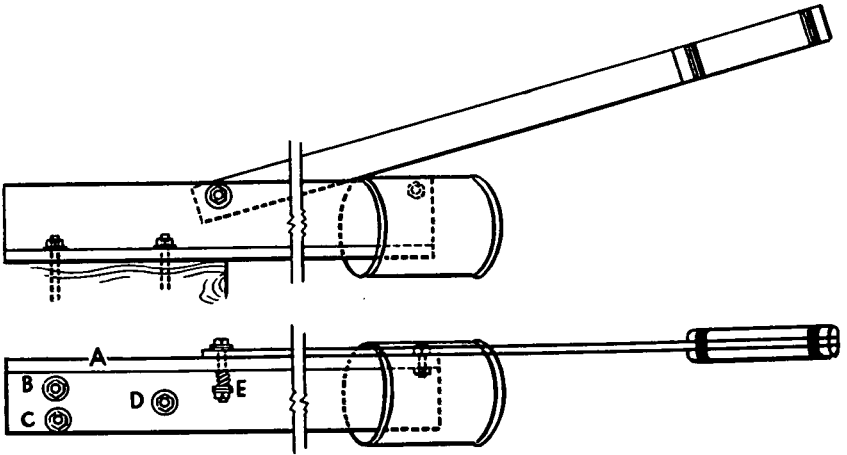


Figure 80. Field-expedient tin-can cutter.

28. Garnishing With Glass Fiber

Glass fiber is light in weight, fireproof, and does not employ strategic materials. Glass fiber garnished netting is available as a substitute issue for steel wool garnished netting, is inclosed between two layers of chicken wire, and comes in eight standard camouflage colors: light green, dark green, forest green, sand, desert sand, field drab, earth brown, and olive drab. See tables XXVIII and XLIV for detailed data. A closeup of wire screen garnished with glass fiber is shown in 1 and 2, figure 81.



1 Wire netting garnished with glass fiber to resemble the texture of grass.

Figure 81. Glass-fiber garnishing.

Section II. ARTIFICIAL TEXTURING MATERIALS FOR GROUND AREAS

29. General

The texturing of ground areas by scarification and the use of natural methods and materials have already been discussed in paragraph 21. This section describes the application of artificial materials to ground areas to add or simulate texture. Roadways and similar areas often are textured, and for this purpose materials should be selected according to their durability under abrasion. Table XXVIII lists the characteristics of many texturing materials, including, in their abrasion rating, their desirability for traffic-bearing surfaces.

30. Adhesives

a. General. In camouflage, adhesives serve to adhere texturing materials to various surfaces. They fix texturing materials to surfaces such as—

- (1) Traffic-bearing surfaces—roadways, runways, and taxiways. For these the adhesive must form a firm, durable bond because the granules also form a wearing surface.



2 Wire netting garnished with glass fiber to resemble the texture of foliage.

Figure 81—Continued.

The kind of traffic using the surface also is important. For example, inflammable texturing materials (wood chips, fabric, feathers) or inflammable adhesives (bituminous emulsion) would create a flame and skid hazard when subjected to jet blasts, and must not be applied on runways or taxiways used by jet aircraft.

- (2) Non-traffic-bearing surfaces, such as roofs, vehicles, and windows. Less durable adhesives serve the purpose, depending on the climate and length of expected service. Durability of the adhesive is determined by the granules used. Some special adhesives, which have a limited usefulness, include ethyl cellulose, varnish, and ordinary glue. These are used for small-scale jobs, such as coating window glass for reduction of light reflectance or blackout control.

b. Sources of Adhesives. Adhesives may be obtained through supply channels, by purchasing commercial adhesives, or by the manufacture of field-expedient adhesives by troops when natural raw materials are available and the necessary equipment can be improvised.

c. Selection of Adhesives. A number of factors influence the selection of an adhesive (table XXV) :

- (1) *Surface.* Whether surface is traffic-bearing or non-traffic-bearing.
- (2) *Size of granules.* Small granules require a dense, light adhesive such as bituminous emulsion. Large-size granules require an adhesive such as asphalt cement.
- (3) *Climate.* The climatic limitations of the different adhesives are included in the tables of adhesives (tables XXII-XXIV).

d. Characteristics of Adhesives. Example adhesive coats are asphalt cement, cutback asphalt, or bituminous emulsion (tables VII, VIII, and XXI). The only distinction between these materials is the form in which the asphalt is applied to the surface. After the asphalt cement has cooled and after the petroleum solvent or water has evaporated from the cutback or emulsion, the remaining asphalt is identical in all three cases.

- (1) Asphalt cement is preferable under ordinary circumstances because it comes ready mixed and dries quickly after application.
- (2) Asphalt, paving grade, with a penetration within the limits of 50 to 100 is the best adhesive for use in areas like the United States. For tropical use, asphalt with a penetration within the limits of 40 to 60 is recommended. For uses in cold climates, asphalt with a penetration between 85 and 100 is suggested.
- (3) Although bituminous emulsion can be applied to damp surfaces, there is danger of a poor bond in the presence of excess dampness. The emulsion will not furnish a satisfactory bond until the original dampness of the surfaces and the water in the emulsion have dried completely. This requires more time than would be required by permitting only the surface to dry and then applying asphalt cement. In tropical climates where high humidity exists and frequent rains occur, the emulsions have proved unsatisfactory because of the time required for the surface to dry thoroughly.

31. Application of Adhesives

Application of adhesives is a simple resurfacing operation. On large areas the best practices of highway construction are fol-

lowed. On any surface, however, do not attempt adhesion of the surface coat when either the surface or the texturing material is wet. If possible, apply adhesives when temperature is high for the locality. The surface and texturing materials must be free of dust, oil, or other foreign matter.

a. Preparation of Surface.

- (1) Wash all types of large-scale surfaces with brush and water. Be sure surface is dry before applying adhesive. Smaller surfaces may require only the removal of dust. Dust, oil, and foreign matter prevent the formation of a bond between the adhesive and the surface and must be removed.
- (2) Apply a priming coat on concrete surfaces. There is no necessity for a priming coat on clean bituminous surfaces.
 - (a) The priming coat consists of a thin asphaltic liquid, relatively low in asphalt content and high in solvent content. Upon application to a non-bituminous surface, the liquid not only will coat the surface with a thin asphaltic film but also will tend to penetrate and seal it; this is particularly important for work done at low temperatures.
 - (b) The priming coat recommended is RC-O, a rapid-curing solution, thinned with about 50 percent white gasoline naphtha. Apply 24 hours in advance of adhesive coat. The rate of application depends somewhat on the skill of the operator, but should be .05 to .1 gallons per square yard, according to the absorptive characteristics of the surface; the heavier application is appropriate for porous surfaces.

b. Methods of Application.

- (1) On large areas, such as roadways, and runways and taxiways not used by jet aircraft, concrete and bituminous surfaces are treated the same. Asphalt is preferred as an adhesive coat, but tar, grade RT-10, may be used. Apply either adhesive with an asphalt distributor or with heavy-duty spray equipment, as shown in figures 82 and 83.
- (2) On small areas, which are either vertical or horizontal, apply adhesive with heavy-duty equipment, by hand-brushing with brooms, or with a swab.

32. Field-Expedient Adhesives

a. In deciding upon an adhesive for emergency use, the following points are considered:



Figure 82. Application of adhesive to runway with brooms and spray equipment.

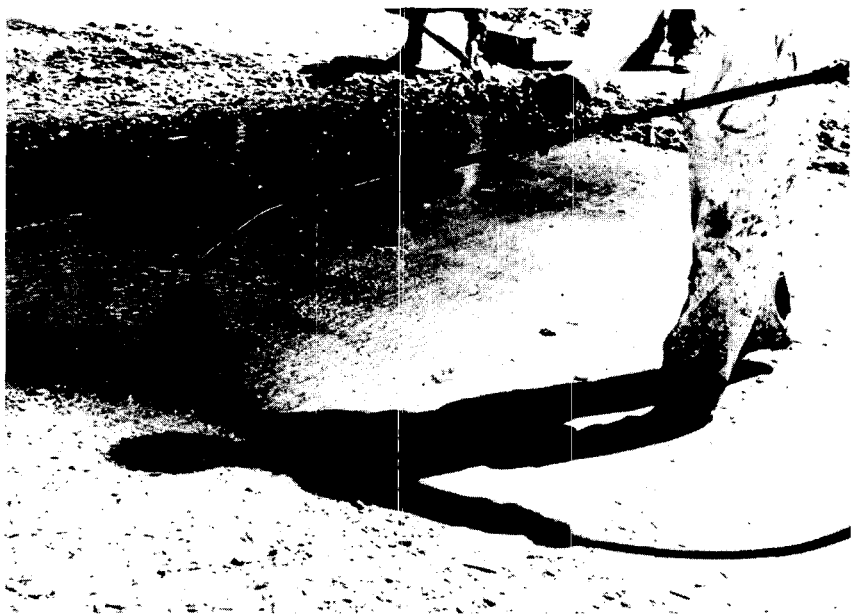


Figure 83. Applying adhesive to runway with spray equipment.

- (1) Availability of solvents or extractants and manufacturing equipment required for their preparation.
- (2) Adhesive qualities of product on type of surface to which it is to be applied.

- (3) Bonding strength of product for texturing material to be used.
- (4) Effect of material being applied upon color and other appearance factors.
- (5) Durability under expected weather conditions.
- (6) Ease of removal to facilitate changes of camouflage treatment if required.
- (7) Time and manpower available.

b. Field-expedient adhesives and sources for adhesives are described below and in tables XXII – XXV.

- (1) Raw molasses as supplied by commercial sugar refineries can be used in areas where cane molasses is available in large quantities. It is unstable and not waterproof. It can be applied by an asphalt distributor or by mobile spray equipment, or it can be brushed on with a broom. Use water to thin out or to remove.
- (2) Crankcase oil or lubricating grease also may be employed. These adhere fairly well to most surfaces and can be covered with earth or similar loose materials. The oil or grease is removed from metal, glass, and similar smooth surfaces with organic solvents such as alcohol and benzene.
- (3) Expedient adhesives can be prepared by boiling certain types of seaweed in water. The type producing the best results is the reddish, or reddish-green, branchy seaweeds. Green, unbranched seaweeds are devoid of mucilage-like constituents. Brown seaweeds, such as the kelps, when boiled in an alkaline solution, such as leaching potash or soda from wood ashes, yield a good adhesive. All types are capable of temporary binding power. They tend to lose their adhesive quality during rain and fog. Most of these adhesives are best applied in a hot state because they gel quickly at body temperature. Dried and fresh seaweed are equally satisfactory as raw material. Complete extraction of the adhesive takes place in 15 to 30 minutes boiling time.
- (4) Native resins and gums are also sources of expedient adhesives. The identity of a gum or a resin-productive species may be determined in any locality from native practices, by consulting proper local governmental agencies, or, as a last resort, by practical experimentations, usually by cutting the bark of trees and shrubs and observing the results such as type of sap, rate of flow, etc. Usually gums and resins are plant exudations, caused by injury to the bark. Some are soluble in water,

others only in alcohol. To gather gums or resins, strips of bark usually are cut to start the flow of the gummy sap. The flow usually is slow; from 2 days to 3 weeks are required before it can be formed into sufficiently large hardened secretions and collected by chipping off with a hatchet. In trees with large trunks, pockets to collect the sap can be notched into the trunk just under the places where the bark has been cut. The sap can be dipped out and immediately used without being boiled down. In many cases a fair quantity of sap can be obtained in a few hours.

- (5) In some areas, fossiliferous resins, which are found in the ground in depths ranging from 2 inches to 3 feet, are a plentiful source of emergency adhesive.
- (6) Natural bitumen is another source of adhesive and is found on the surface of the ground in certain areas of Portugese East Africa, West Indies, southern Australia, and the Aleutian Islands.

c. All field-expedient adhesives are emergency substitutes and are not as satisfactory as the standard products: bituminous emulsion, asphalt cement, or cutback asphalt. Before it has been decided to use these substitutes on a large installation, consideration must be given to the amount of time, material, and manpower needed to improvise them.

33. Sources and Preparation of Texturing Materials

a. *Availability.* To determine the availability of native materials in civilized regions, investigate the byproducts and waste of local factories, mills, shops, slaughter houses, and mines. In uncivilized regions, most likely sources of materials are salvage depots, quartermaster depots, and local agricultural enterprises. Texturing materials are not items of issue.

b. *Pretexturing.* When a concrete surface is laid texture can be built in by brushing the surface to expose aggregate just prior to final set. Both concrete and bituminous surfaces can be textured by applying a bituminous seal coat covered with selected aggregate. Textures and colorings may be varied by the selection of aggregate possessing different colors and various degrees of coarseness. This type of surface has good texture, but it also has an abrasive effect.

c. *Coloring.* When texturing materials do not match the color of the surroundings, they can be colored before application or painted after application. Coloring before application can be done by mixing the surfacing material with paint in a concrete mixer.

34. Application of Texturing Materials

a. General. When asphalt cement is used as the adhesive, the texturing material is applied immediately following the application of the adhesive coating. When the adhesive is bituminous emulsion or a cutback, the texturing material is applied shortly after the adhesive has become tacky—normally 10 to 15 minutes later. Texturing materials are applied in various ways. The most expeditious method is to use a mobile wood-chip distributor, as described below. Another method is to dump piles of the material at the sides of the area to be covered and spread it by hand shovel. Another way is to scatter them from the back end of dump trucks. The trucks are driven in reverse so as not to run over the untextured adhesive surface itself. As soon as the materials have been spread, they are rolled with a heavy rubber-tired roller or a 5-ton, or heavier, road roller (fig. 84.) This is essential in order to force the granules deeply into the adhesive. The surplus granules can be removed by sweeping after the adhesive has set.

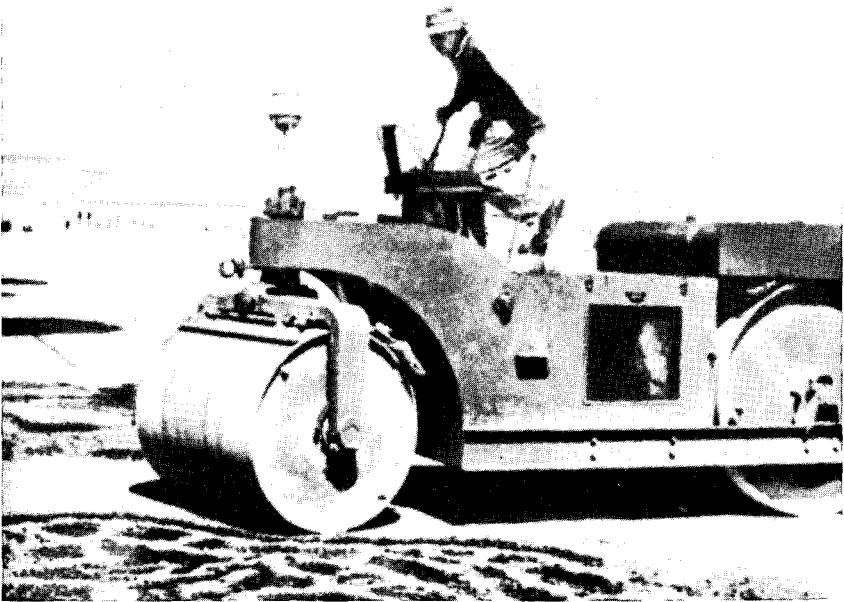


Figure 84. Textured pattern on a parking apron is rolled to force granules into adhesive coating.

b. Expedient Distributors for Texturing Materials.

(1) No distributors for texturing materials are issued.

Granule guns are available commercially in the United States. These guns are suitable for use in distributing texturing materials such as slate granules. The sprayer consists of a metal tank mounted over a small electrically driven blower. Granules are distributed evenly and economically on the adhesive through a metal pipe about 2 feet long. The apparatus is equipped with a shoulder container which permits the replacement of granules without interrupting operation of the machine.

- (2) Distribution of texturing on a large scale can be accomplished by any suitable, commercial, road-building equipment or farming machines, such as manure spreaders.
- (3) One field-expedient texturing distributor has been adapted by mounting an ensilage blower on a frame, its outlet horizontal to the ground (fig. 85). An 8-horsepower gasoline engine, also mounted on the frame, is used as a power unit to operate the blower. A hopper for loading from a dump truck to the blower is arranged at approximately a 45° angle to facilitate the transfer of chips from the truck bed to the blower. The entire unit is mounted on wheels and has a pin type hitch to fasten the rig to the rear of a truck. Attached to the blower discharge is a flexible 6-inch tube, 5 feet in length, which allows chips to be sprayed with a sweeping motion, the operator having control of the rate of application. The platform on the blower unit is so arranged that the operator of the spreader can ride on the machine as it is being towed by a truck. The rate of application of wood chips by this method averages approximately 40,000 square yards per 8-hour day. Any light weight material, such as wood chips, may be applied with this machine. Figure 86 shows several views of various types of texturing materials.

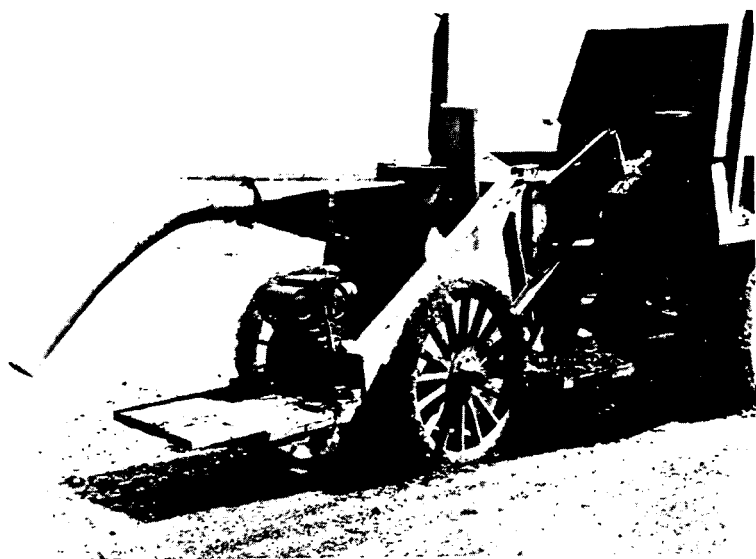
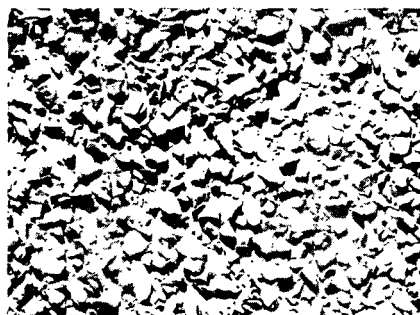
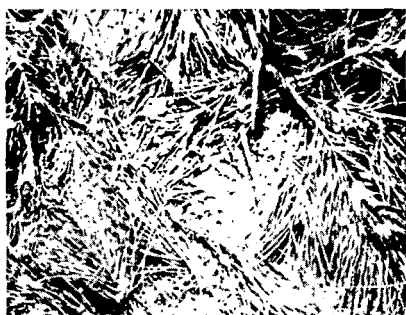
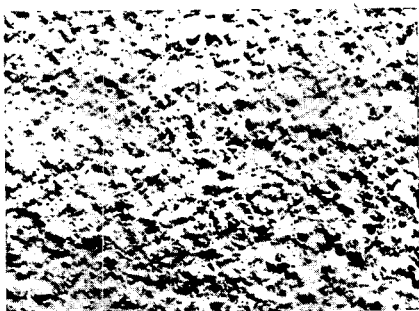


Figure 85. Expedient granule distributor.



- 1 Pine-bough-tip texturing, vertical and oblique views.
- 2 Rock chips, vertical and oblique views.

Figure 86. Views of applied surface-texturing materials.

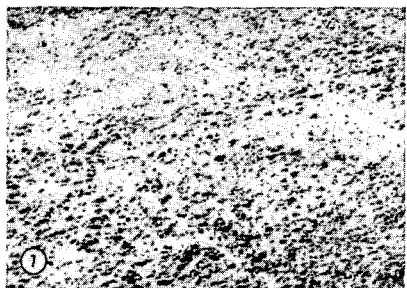
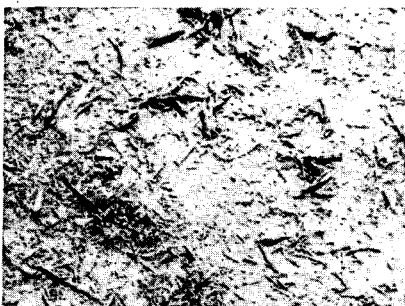
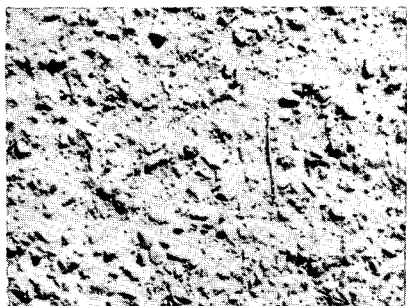


3 Wood-chips texturing, vertical and oblique views.
4 Slag, vertical and oblique views.



5 Excelsior, vertical and oblique views.
6 Feathers, vertical and oblique views.

Figure 86—Continued.



- 7 Gravel, vertical and oblique views.
8 Redwood fiber, vertical and oblique views.

Figure 86—Continued.

CHAPTER 5

NATURAL MATERIALS AND VEGETATION IN CAMOUFLAGE

35. General

In all camouflage planning natural materials are used whenever practicable because of their availability, their adaptability, and their excellent camouflage properties. Natural materials may provide two-dimensional camouflage having only length and width or three-dimensional camouflage having length, width, and height. In order to use live vegetation properly, camouflage supervisors should be familiar with the common characteristics of living plant materials and the techniques of planting, fertilizing, transplanting, and processing vegetation. However, for best results, the advice of experts should be obtained; this is especially important in overseas theaters. Possible sources of competent advice (in the absence of Corps of Engineers specialists) and of raw materials include—

- a. Local universities.
- b. Governmental agencies—agricultural and forestry branches.
- c. Nurseries.
- d. Local garden clubs or similar organizations.
- e. Local farmers.

36. Types of Natural Materials

a. *General.* There are three types of natural materials; live vegetation, cut vegetation, and the inert covering of the earth, such as soil, rocks, and gravel.

b. *Live Vegetation.* Except for coniferous vegetation, live vegetation is available almost universally except in desert regions and extreme arctic regions such as Greenland, is permanent, improves with continued growth, and requires a minimum of maintenance. However, the planting or transplanting of plant material requires time, skilled labor, and an adequate water supply, especially in the early stages; if large trees are to be transplanted, heavy equipment is necessary.

c. Cut Vegetation. This is available in adequate quantities in most regions. However, it requires maintenance, differs from live vegetation in its range of infrared reflectance, and is inflammable.

d. Inert Substances. Those of value, such as colored soil and crushed rock, provide either a change of color or texture or both and are normally available in large quantities.

37. Characteristics of Live Vegetation for Camouflage Purposes

For each planting project the key to proper selection of plants will be furnished by an investigation of what is already growing well in the locality. Plants may be native or thoroughly naturalized; those varieties found thriving under adverse conditions are likely to be especially desirable. Only plants capable of growing under conditions at the actual site of planting are used; fertility of soil, wetness or dryness of ground, and degree of exposure to wind and salt air (if near bodies of salt water) must be taken into account. The following characteristics are desirable:

a. Ability to Survive. This is dependent on—

- (1) A normal, vigorous root system.
- (2) The use of native or naturalized plants rather than imported species.
- (3) Freedom from disease, insect pests, and abrasions of the bark.
- (4) Rapid establishment and growth without undue care.

b. Coverage.

- (1) Adequate fullness or thickness of the foliage.
- (2) Adequate ground covering capacity of the plant.

38. Types of Vegetation

The kinds of vegetation useful for camouflage purposes include—

- a.* Legumes and low-growing plants.
- b.* Grasses.
- c.* Vines, deciduous or evergreen.
 - (1) Horizontal-growing varieties.
 - (2) Vertical-growing, twining or clinging on supporting objects.
- d.* Shrubs, deciduous, evergreen or broadleaf.
- e.* Trees, deciduous, evergreen or broadleaf.

39. Use of Vegetation in Camouflage

The type of vegetation and the method of using it are largely determined by the camouflage plan. Vegetation may be used for two different purposes—to ground-pattern the earth surface by

changing its color or texture (pars. 21 and 22) or to provide overhead cover (par. 11). Another simple but effective use is that of breaking up otherwise familiar outlines of military equipment and vehicles. Use of foliage with armored vehicles has been described in paragraph 12. Either method, when properly employed, blends the treated area with its surrounding.

40. Limitations of Live Vegetation in Camouflage

At least five factors limit the range of choice of vegetation and the practical methods of employment:

- a. Ability to complete the job in time to be effective.
- b. Availability to provide effective camouflage of sufficient plant material and its ready adaption to growth.
- c. Availability of sufficient trained labor.
- d. A sufficient supply of water.
- e. Availability of tools, supplies, and equipment.

41. Choosing Cut Foliage

a. *General.* Foliage material should be selected that will last for several days and not turn brown and die within a few hours.

b. *Selection Principles.*

- (1) Do not cut foliage from the following plants for camouflage purposes; willow, aspen, butternut, walnut, feathery leaved acacia, and American ash. Foliage from these trees withers rapidly.
- (2) Choose branches which have been growing in direct sunlight.
- (3) Choose foliage with leaves that feel tough to the fingers.
- (4) Cut foliage at night, early in the morning, during a rainstorm, or in heavy fog. It stays green longer than foliage cut in direct sunlight. This is especially true if branches are to be supplied with water.
- (5) When cut foliage is placed in the same relative position as when growing, it will stay green longer. If leaves are turned upward, an unnatural appearance results and the tender undersides of leaves turn brown quickly from exposure to direct sunlight, thereby losing their value for camouflage.
- (6) Recutting stems as soon as the first signs of wilting appear materially lengthens the life of cut foliage supplied with water. When practical, make cut under water.

c. *Characteristics of Species.*

- (1) Softwoods and hardwoods are the two principal kinds found outside the tropics. Table XXXIII lists the lasting

qualities (for camouflage purposes) of cut hardwood foliage.

- (a) Softwoods, known also as conifers, are evergreen trees with needle-like leaves. This group includes pines, spruce, fir, larch, hemlock, cedar, juniper, cypress, and many others. Larch and southern bald cypress, however, lose their needles in winter. Foliage of softwoods lasts much longer than foliage of hardwoods and should be used wherever available and appropriate. Pines and spruces last from 1 to 2 weeks. Hemlock and larches are the poorest of the softwoods for camouflage and last from only 2 to 4 days.
 - (b) Hardwoods, also known as deciduous trees, are broad-leaved. Oaks, maples, and all other trees and shrubs except softwoods ((a) above) and such tropical plants as palms and bamboos are hardwoods. Each species of hardwood has different lasting qualities. Different members of the same species have similar qualities. For example, the foliage of gray, paper, yellow, and black birches stays green for about the same period of time, and for camouflage purposes it is only necessary to know that birches as a group last 3 to 4 hours in direct sunlight without water and 1 to 2 days if their stems are placed in water. Table XXXV lists the lasting qualities of hardwood foliage without water.
 - (c) European hardwoods have much the same characteristics as their American counterparts. In fact, members of the same group of plants all over the world react in about the same way under similar conditions. It should be remembered, however, that sunlight is more intense in the tropics, and foliage will dry out and brown more quickly after cutting than will similar foliage in the United States or Europe.
- (2) Table XXXII lists certain tropical plants, the foliage of which possesses good lasting qualities when cut.

42. Foliage Preservatives

Where wilting is a serious maintenance problem or natural growth for replacement is scarce, methods of preserving natural materials are used.

a. Calcium Chloride.

- (1) Foliage treated with calcium chloride and painted with oleoresinous paint will last from 5 to 6 months. The

treated and painted foliage is pliable, tough, durable, and fire resistant.

- (2) The leafy branches are soaked in a solution of 6 pounds of calcium chloride to 1 gallon of water. From 4 to 6 days continuous immersion is required for foliage to become impregnated. It is then removed to dry. Shorter repeated immersions of from 2 to 24 hours reduce the total time of actual immersion required to about 30 to 40 hours. Between dippings foliage should be covered to prevent drying out, allowing further impregnation by the solution retained on the foliage. The overall time is longer, but this method makes it possible to treat more material by rotating several batches. Most lasting results are obtained from coarse, leathery-leaved growth such as holly, live oak, mountain laurel, magnolia, and the like. Finely textured leaves such as maple or birch do not attain as high a lasting quality.
- (3) To test impregnation, hang some treated leaves all day to dry. If the leaves become brittle, further impregnation is required until the leaves become pliable.

b. Ammonium Thiocyanate and Sorbitol.

- (1) Complete penetration and preservation of foliage may be obtained on most deciduous leaves in from 4 to 8 hours total immersion time, and on thick leathery leaves in from 10 to 12 hours. Short—15 to 30 minutes per day—successive immersions, allowing for rotation of materials, produce similar results with less total immersion time.
- (2) The mixture consists of 25 pounds of ammonium thiocyanate (commercial grade) to 10 pounds of sorbitol (commercial grade) to 100 pounds of water to 0.2 pounds of wetting agent ("Duponol," "Alkanol," or "Span" type), if available, which speeds impregnation.
- (3) The solution is prepared by adding ammonium thiocyanate to the water, then stirring in sorbitol and, if available, the wetting agent.

c. Water. The use of water will prolong the natural appearance of cut foliage (fig. 87). A rule of thumb to remember is that unless branches will stay green in water for at least 2 or 3 days, it is not worthwhile to supply it. A quart of water a day will be ample for most branches 6 feet long. Use clear fresh water, never salt or brackish water.

43. Planting Vines

a. General. Vines, particularly climbing varieties, offer almost

unlimited opportunities to provide cover because of their easy availability, rapid growth and spread, and the comparatively little care they require (fig. 88). Table XXXIV lists some of the rapid, tall-growing varieties suitable for camouflage purposes in temperate climates. Many others are useful in the tropics.

b. Transplanting. Seasons and methods of transplanting are the same as for shrubs; see paragraph 46.

c. Training Vines. Train climbing vines from earliest growth and throughout the life of the plant to achieve maximum effectiveness of covering. Tie branches of vines which have no natural method of attachment to a support with soft twine or with loose loop of leather or cloth. Do not use staples.

d. Propagation of Vines. The easiest and quickest methods of propagation for the majority of species are—

- (1) Transplanting vines; see paragraph 47.

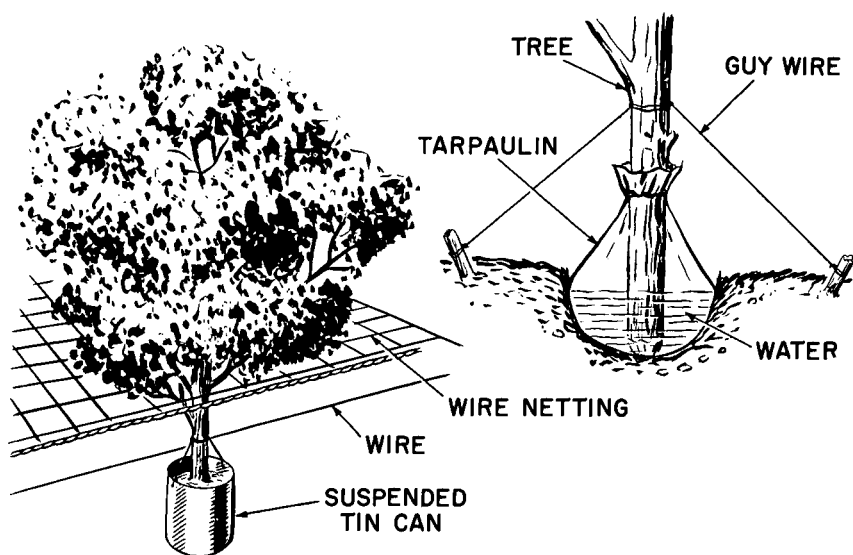


Figure 87. Supplying water to cut foliage and trees.

- (2) Sowing seeds of rapid-growing annuals in the spring. Be sure that hard seed coat is cracked by filling or cutting to allow the entrance of water, thus insuring prompt germination.
- (3) Root cuttings, several inches long and buried a half inch deep in boxes of sand through the winter, are taken out and planted in the spring. This method is limited to a few species.
- (4) Layering is a method of propagating vines by rooting

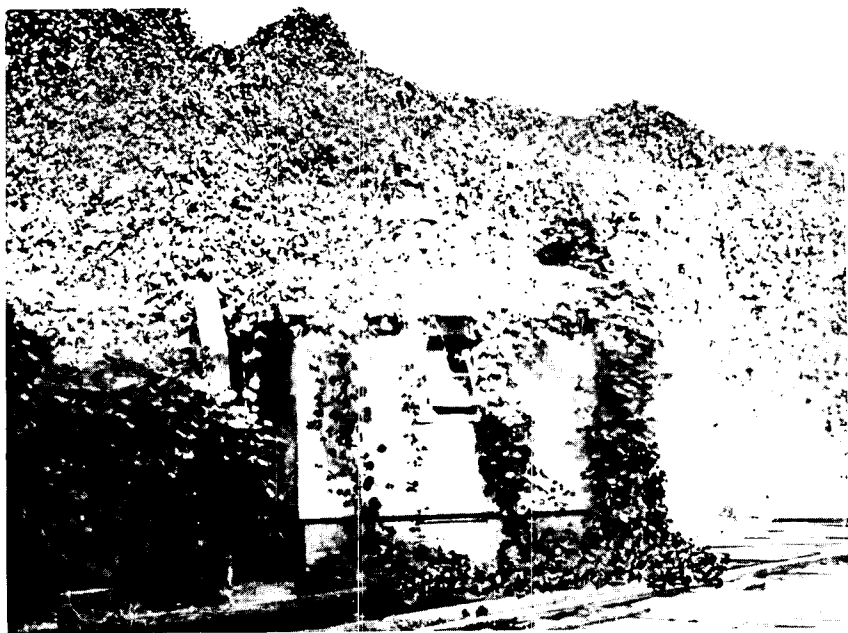


Figure 88. Native vines planted to screen installation.

their branches. Lay the branch of a plant on the ground, cover it with soil and water it plentifully. Roots will start to grow in several places on this branch. The new plants can be severed from the old and transplanted as soon as the roots are well formed.

44. Transplanting Small Trees and Shrubs

Transplanting involves moving trees or shrubs from one location to another in such a manner that they will continue to grow. Considerable care must be taken to secure satisfactory results. Among preventable causes of failure are: root systems shortened too much or otherwise mechanically injured when trees are dug up; drying-out at some time between digging and transplanting; freezing of roots while out of the ground; and, after transplanting, loss of moisture from tops faster than the roots can replace it.

a. Planting Seasons for Transplanting Trees, Shrubs, and Vines. Off-season planting is to be avoided wherever possible. With great care and much added expense plants can be successfully moved at seasons ordinarily regarded as unfavorable; but will remain in a very depleted condition giving little or no leaf effect until the following natural spring growing season. Thus, frequently, nothing is gained. The most favorable times for planting are as follows:

- (1) *Temperate zones.* The best seasons for planting deciduous material are in the fall after the first frost and before freezing of the ground, and in the spring after thawing of the ground and before the appearance of leaves. For evergreen material in more northerly zones, the most favorable seasons are in the late summer after new growth has hardened and somewhat later in the spring than for deciduous plants. Farther south in the temperate zone, where the ground freezes but little, deciduous plants may be removed during this same period.
- (2) *Subtropical and tropical zones.* In these zones there exist no such definite planting seasons, and it is possible to move most plants with fair success at any time not a period of flush growth. Palms and bamboos are peculiar in that they are most easily handled in early summer. Oaks, including live oaks, are difficult to transplant, except during the winter when they are dormant. In the sub-tropics much is to be gained by planting during cooler months, unless plants are container-grown or otherwise handled with special care.

b. Bill of Materials and Equipment. Following are data for transplanting shrubs and small trees up to approximately 3-inch trunk diameter as measured 1 foot above ground:

- (1) Hand tools: picks, shovels, wrecking bars, spading forks, pruning shears, knives, and saws.
- (2) Trucks ($\frac{1}{2}$ ton or larger).
- (3) Ordinary burlap 40 inches wide or coarsely woven cotton fabrics.
- (4) Strong twine or light rope.
- (5) Stakes or posts, and wire rope, or 10-gage wire, for bracing or guying.
- (6) Strips of durable paper or burlap for wrapping trunks.
- (7) Short lengths of rubber hose to protect trunks from guys.
- (8) Peat moss or humus or equivalent at planting site.
- (9) Equipment for bringing water to planting site.
- (10) Wax emulsion (commercial, desirable but not essential).
- (11) Issue spraying equipment.

c. Procedure in Digging Trees for Moving with Exposed Root. Deciduous trees up to 15 or 20 feet tall usually are moved with bare roots if season is favorable for moving. The favorable seasons for temperate zone and tropical trees are discussed in *a* above. Large specimens sometimes can be moved with bare roots.

- (1) If tree is in leaf, spray top of selected tree with wax emulsion; use care to cover underside of leaves thoroughly. This step is desirable, but not essential.
- (2) Dig a trench around the selected tree outside the estimated spread of roots. A 5-inch radius from the tree for every inch of trunk diameter and a depth of about 18 inches will usually avoid serious cutting of roots (fig. 89).
- (3) Remove soil from roots by using a spading fork and working inward from the trench. Insert it first in the inner face of the trench and pull it away from the trunk with a combing action. Continue until most of the roots are exposed almost to the trunk.
- (4) If the tree is exceptionally rooty and requires protracted digging, one section of the root system should be thoroughly uncovered before starting on another. Enough soil is left under the trunk to support the tree until the lateral roots have been loosened and uncovered.
- (5) Lay wet burlap over the exposed roots or wrap it around them to prevent drying or other injury while digging proceeds.
- (6) Tip the tree over after most of the roots have been uncovered and loosened. Use care to avoid straining or breaking roots which are still holding. If a strong tap-root is encountered, dig deeper to preserve it.

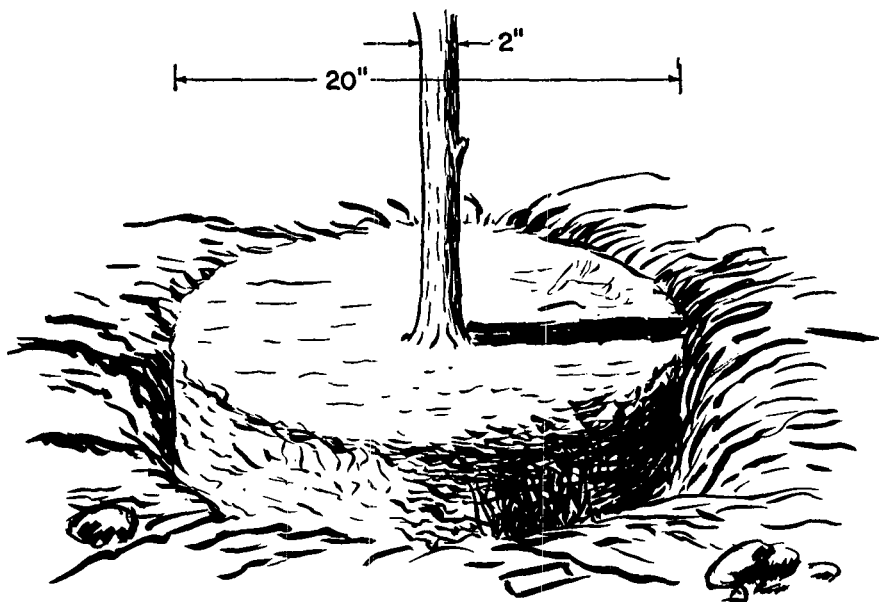
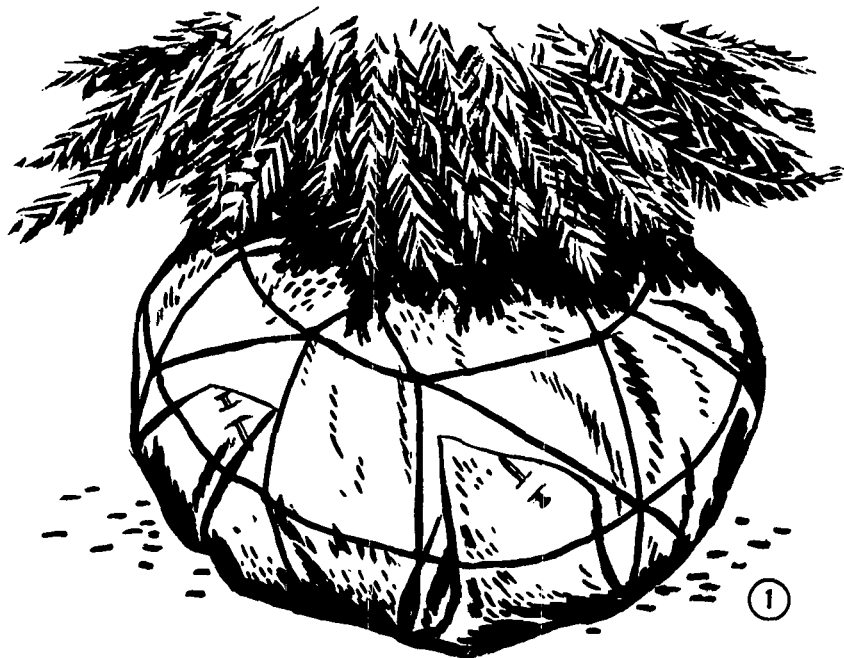


Figure 89. Diagram showing method of trenching around tree.

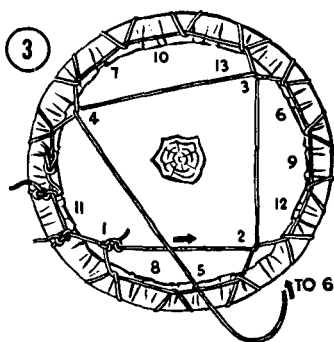
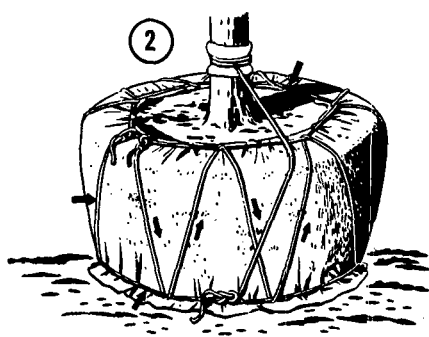
d. Procedure in Digging Trees for Moving With Balled Roots. Evergreens and deciduous trees and shrubs are moved with roots kept intact in balls of soil, during unfavorable seasons, to minimize injury. The width and depth of a ball of soil depends on the formation of the roots. In most cases a width (diameter) of one foot of ball for each inch of trunk diameter is sufficient.

- (1) Mark circle around selected tree a little larger than intended width of finished ball.
- (2) Dig trench just outside the mark, its inner face vertical and a few inches deeper than the lower roots. When roots are encountered, they are cut off flush with face of trench using pruning shears or saw in case a clear cut cannot be made with a sharp spade.
- (3) Trim off surplus soil to shape the ball. Work with back of spade toward the trunk. Trim the sides to slope inward so width of bottom is a few inches less than top. Surface of root ball is finished smooth with no projecting roots.
- (4) If ball is small—less than 18 inches in width—cut under it and tip it over onto a square piece of burlap. Lift it from the hole by the corners of the burlap.
- (5) Draw the burlap tightly and pin it in; lace with 8d nails. Reinforce this wrapping with strong cord laced several times around the ball and drawn up tightly (1, 2, and 3, fig. 90).
- (6) Balls larger than 18 inches in width are burlapped and reinforced while still in place to avoid crumbling the soil.
- (7) Cut well under the ball, leaving enough soil under the center to support the tree.
- (8) Place burlap around the root ball and pin it in place.
- (9) Tie a loose loop of rope (top collar) around the trunk.
- (10) Tie a loose loop of rope (lower collar) with a running bowline at bottom of ball.
- (11) Pass the lacing cord over and under the collar ropes at intervals of 6 to 8 inches around the ball.
- (12) Tighten the lower collar rope and tie it firmly.
- (13) Draw up the lacing cord to strain it at each lap by taking up the slack of one lap and pulling tight on the next. This same action must be applied to alternate laps of the lace cord clear around the ball.
- (14) Use a piece of strong canvas or doubled burlap to serve as a cradle for lifting and loading the ball.
- (15) Do not lift balled trees by the trunk or top. Balled trees

too large to manhandle are lifted and loaded by systems of skids and rollers or by special tree-moving machinery.



Sketch showing burlap wrapping of a balled root system and method of fastening and binding.



- 2 Side lacing method used wrapping balled root system.
- 3 Sketch of top lacing.

Figure 90. Wrapping of root systems for transplanting.

e. Procedure for Root Protection. The sooner freshly dug trees are replanted the better, provided conditions are suitable. If delay is necessary, dormant trees can be kept for some time with little deterioration if the roots are buried or "heeled in" where the drainage is good.

- (1) Make a trench as wide and deep as necessary to receive the roots.
- (2) Place the trees along the trench in an inclined position. Cover roots and lower portions of the trunks with moist soil. A second layer or successive layers of trees may be placed on this moist soil and covered separately.
- (3) Inclined heeling-in is recommended for smaller shrubs and for trees with compact root systems. Medium trees with spreading root systems are heeled vertically. Evergreens require a shady place for heeling-in and daily sprinkling of water on their tops in warm weather.

f. Procedure in Transplanting at Site. If soil is not of good quality, as determined by the native growth in the area, bring in loamy soil. Topsoil from land producing good crops may also be used. Most soils are deficient in humus and are improved by thoroughly mixing in a fourth or more by bulk of well-rotted (not fresh) manure, partially decomposed leaves, peat, or peaty woods soil.

- (1) Dig holes sufficiently wide and deep to accommodate roots without cramping (fig. 91).
- (2) If topsoil is to be used, pile it separately from the subsoil. Soil used for backfill must be moist.
- (3) Put in 3 or 4 inches of prepared soil on which roots will rest.
- (4) Place a low mound of soil in the center of the hole. When large trees are involved, use enough to avoid air pockets.
- (5) Place tree and adjust its position so it stands at same depth as in its former location. Orient tree for best effect.
- (6) Spread out roots to approximately their original position, and place soil around them to cover and hold them in place.
- (7) Put in and trample successive layers of soil, being careful to prevent the tree from settling too much.
- (8) When hole is nearly filled, pour in water and allow it to soak away. In humid regions, this water is not always necessary, but is recommended because it brings the soil particles in close contact with the roots.

- (9) After the water has soaked down, fill the hole with loose soil. Allow the soil to settle, then fill up the hole to ground level.

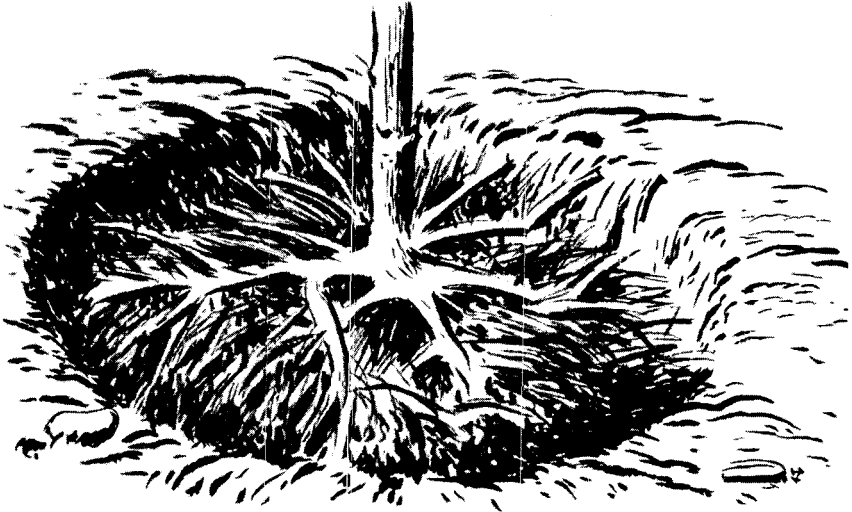


Figure 91. Hole sufficiently wide and deep to accommodate root system of tree being planted.

g. Procedure for Planting Balled Trees.

- (1) Dig holes a foot wider and 4 to 5 inches deeper than the size of the ball.
- (2) Place a low mound of earth in the center of the hole and rest the tree on it.
- (3) Adjust position of tree so it stands at same depth as in its former location. Orient tree for best effect. Put in enough soil to hold it in place.
- (4) Remove the ropes from the ball, pull down the burlap, and cut away the upper portion, leaving the lower portion beneath the ball.
- (5) Half fill the hole with soil and trample it to fill all air pockets.
- (6) Pour in water to fill the hole. After it has soaked down, fill with soil to ground level.
- (7) Make a ridge of soil 3 or 4 inches in height in an irregular ring around the trunk at the outer edge of the ball to reduce the runoff of water. Rake down this ring in winter to prevent water from standing and freezing,

and causing bark injury. The ring is used for the first and second summers after transplanting.

h. Pruning. Pruning is necessary to establish a balance between root system and top growth, especially after transplanting. If there has been a marked reduction in the number or length of roots prior to moving, there is bound to be insufficient sap for maintenance of the top. Pruning requires some skill and experience, but lacking that, tree experts may be consulted or the following suggestions used as a guide.

- (1) Cut away all limbs weakened or injured by moving.
- (2) Cut away at uniform distance from limb tips all around the tree, enough leaf-bearing wood to balance the loss of roots in transplanting.
- (3) Dispose of the cut wood immediately, as it may be the breeding place of tree borers.
- (4) Protect all cut and injured surfaces over 1 inch in diameter by applying commercial tree-surgery dressing or white-lead paint thinned with raw linseed oil.

i. Maintenance of Transplanted Trees.

- (1) Trees taller than 6 or 8 feet planted in exposed areas require some support to reduce swaying by the wind; with resulting disturbance of the roots. For trees up to 15 feet tall, one or more strong stakes are driven deeply into the ground at a distance of about 3 feet from the trunk. A short length of garden hose, through which fasten the tree to the stake. Strips of webbing, strong a wire has been passed, is made into a single loop to fabrics, or soft ropes may also be used. If still stronger support is needed, use 3 stakes. Only a single loop is used for each fastening to a trunk. It must never be so tight that the trunk will be constricted.
- (2) Exposed trunks of newly planted trees are sometimes injured by sunscald. This is prevented by wrapping trunk and larger branches with spiral bandages made from strips of paper or burlap about 5 inches wide. The bandage is applied by starting at top and wrapping it around the trunk spirally, overlapping the material half its width so the trunk is covered with a double thickness. This wrapping is reinforced, if necessary, by binding it with twine wound spirally in the direction opposite to that of the bondage.
- (3) It is especially important that transplanted trees receive sufficient water during growing seasons for the first two years, from early spring until autumn. As a general rule, one thorough soaking each week during the

growing season is sufficient. In watering transplanted trees, slowly saturate the soil until water is standing free on top of root ball. Water gently, holding hose in bucket or box so that water overflows and soaks into ground. Excess water is injurious; avoid a waterlogged condition of the soil.

- (4) Apply a mulch of several inches of leaves, peat, straw, or other material to keep the surface cooler in summer and to reduce the loss of moisture by evaporation. Mulching is recommended for trees planted in the autumn where deep freezing of the soil is expected.

j. Care of Transplanted Trees. Trees should be watched and inspected during the first two growing seasons after transplanting to see that they are growing as they should. Make inspections at least three times the first season, and two or three times the second season, in order to insure that new root growth is developing, no air pockets have formed around roots, soil is fertilized and has sufficient moisture content, dead branches are pruned, and tree is not leaning.

45. Transplanting Large Trees

The transplanting of large trees is expensive in terms of time, equipment, and labor. It should not be undertaken normally unless the nature of the military installation or its relative permanence warrant such extensive treatment. The precautions in preparation and in transplanting are the same as described in paragraph 44. In loading, moving, and unloading, additional requirements are heavy and special equipment, complete knowledge of road conditions, overhead clearances, and weights so that roads and bridges on the route may be passed safely. All these factors are investigated and the best route chosen beforehand. During loading and moving, all safety precautions possible are observed. The transplanting of large trees is not recommended for field camouflage purposes.

CHAPTER 6

DECEPTIVE AND DECOY CAMOUFLAGE MATERIALS

46. General

Few decoy or deceptive camouflage items or materials are issued. Specific conditions in a theater will dictate the need for decoy installations and the materials required. In most instances expedient materials will be adequate for all such installations. The success of most decoy camouflage efforts is dependent upon the ingenuity and inventiveness of the camouflage personnel concerned. Since the purpose of deceptive camouflage is to invite enemy attention and possible attack, the materials used need not be durable or of a permanent nature. It should be remembered that deceptive camouflage is primarily a tactical or operational measure and its employment is subject to command decision. For detailed coverage of the use and employment of deceptive and decoy equipment and materials, see other manuals in the camouflage series.

47. Decoy Camouflage Materials

a. Issue Materials. Prefabricated simulators are the principal issue items available. These are pneumatic replicas of tanks, guns, jeeps, and other military equipment. Decoy lighting sets for simulating blackout airfields also are issued.

b. Expedient Materials. Field expedient materials for constructing deceptive and decoy camouflage include any and all materials that may serve the purpose. Lumber and other structural material, cloth, canvas, paints, screening materials, and patterning and texturing materials are all useful in preparing decoys. Very large and semipermanent camouflage decoy installations may require the employment of many special materials and methods.

48. Construction of Decoys (Nonplastic Materials)

a. General. Specific instructions for the construction of any one type of decoy and the materials to be used cannot be given.

Following are some typical examples of successfully employed decoys. The camouflage officer will use his own discretion as to what materials are best suited for a particular situation.

b. Tanks, Guns, and Similar Equipment. Logs, posts, timber, canvas, cloth, and paint are the principal materials used to construct the decoys as shown in figures 92 and 93. The dummy gun crew with the antiaircraft gun in figure 92 are straw-stuffed figures dressed in issue clothing and helmets. This installation is very effective as a decoy both from air and ground observation.

c. Use of Wheeled Vehicles in Simulation of Tanks. Canvas-painted tanks have been constructed as a superstructure over smaller wheeled vehicles. When maneuvering over soil, each vehicle should be provided with a dragbar to stir up the dust and lend realism to the display. This device has been effectively employed as a deceptive measure.



Figure 92. Decoy field gun, expedient construction.

d. Decoy Railroad Installations. Complete railroad installations including track and rolling stock are not too difficult to simulate if sufficient time is available. Figure 94 shows a section of decoy track with ties simulated by painted strips and track made of two by four lumber coated with aluminum paint. Figure



Figure 93. Decoy tank on wooden frame, expedient construction.

95 shows track made of flattened tin cans. Cars and engines may be constructed of painted canvas or cloth over light timber framework. Similarly, existing cars can be changed to simulate different types. The diesel engine, shown in figure 96, has been changed to simulate a box car by the addition of a light framework covered with painted canvas.



Figure 94. Decoy railroad track made with lumber and paint.

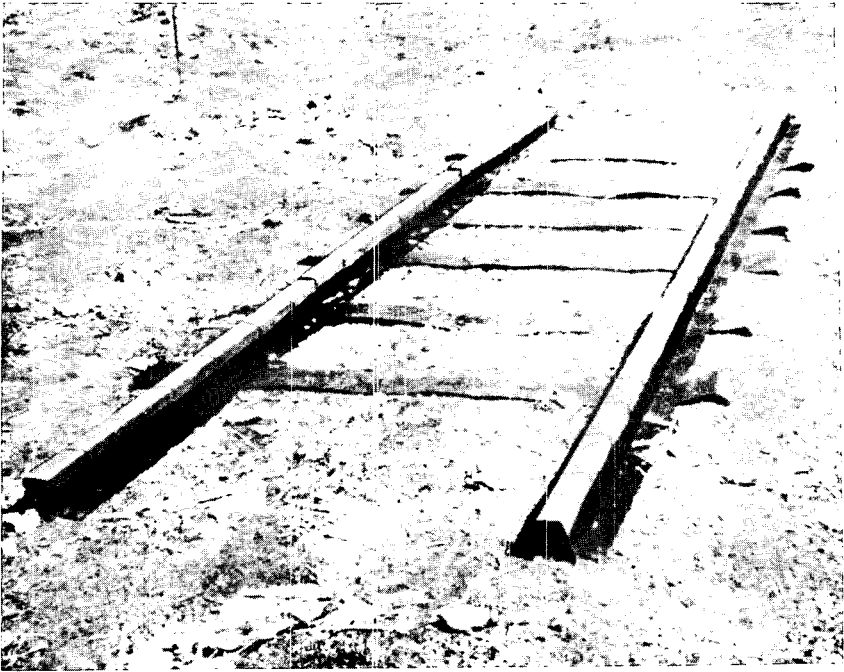


Figure 95. Simulated railroad track made of tin cans.

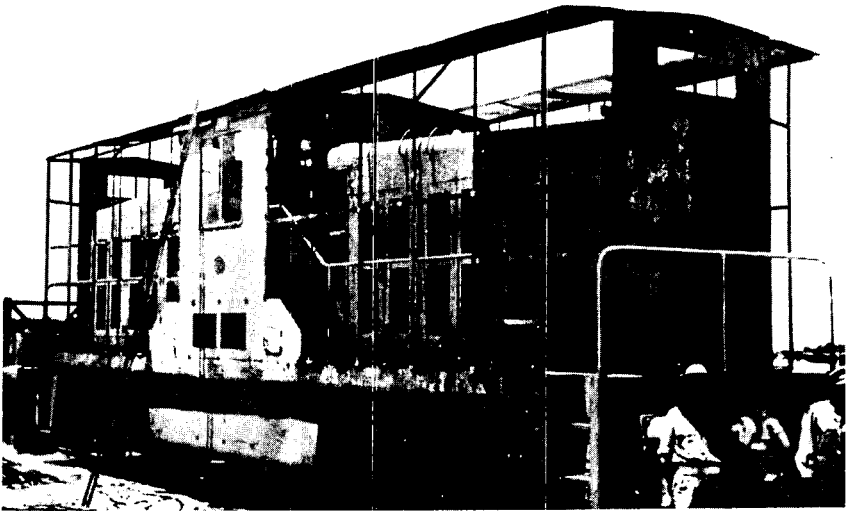


Figure 96. Diesel engine disguised to simulate boxcar.

e. Decoy Airfield Construction. Many camouflage materials and techniques are used in the construction of a decoy airfield. Techniques for simulating runways have been described in paragraphs 19, 20, and 21. Simulations of buildings, parked planes, and similar features can be made of light frame work covered with painted fabric. Decoy anti-aircraft or other guns can be made as described above. Activities normal to a real installation should be simulated, including use of decoy lighting sets. The real airfield installation must be carefully and completely camouflaged and day and night camouflage discipline rigidly enforced to insure the success of the deceptive effort. Figures 97, 98, and 99 illustrate decoy airfield installations.

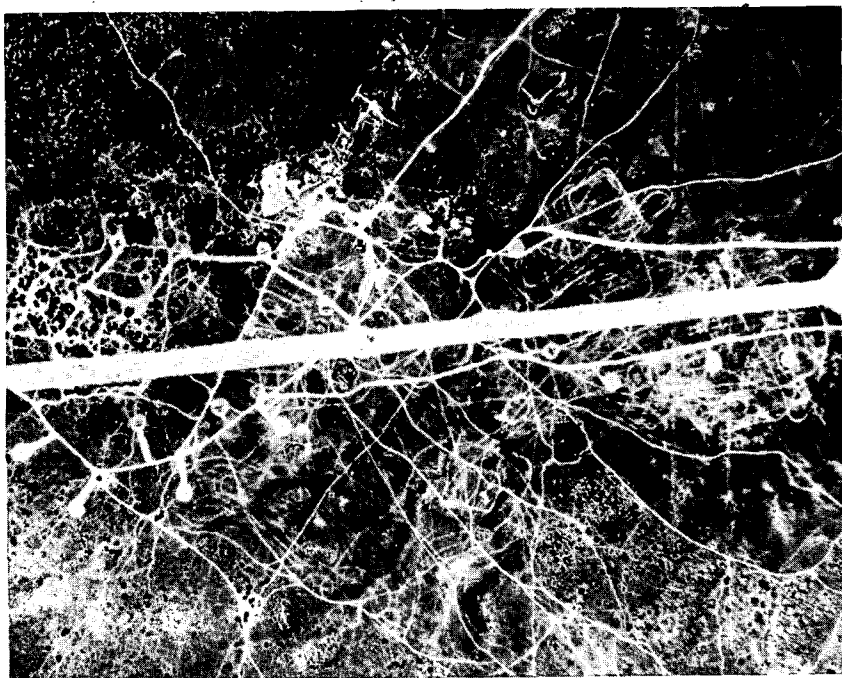


Figure 97. Vertical air view of decoy airfield installation.

f. Construction of Decoy Floating Bridge. Good ingenuity has been displayed in the construction of the decoy ponton bridge illustrated in figure 100. Barges have been anchored in position and the roadway simulated with painted canvas stretched across

the false pontons. Guy lines and other features of a real bridge have been installed to add realism to the deception.

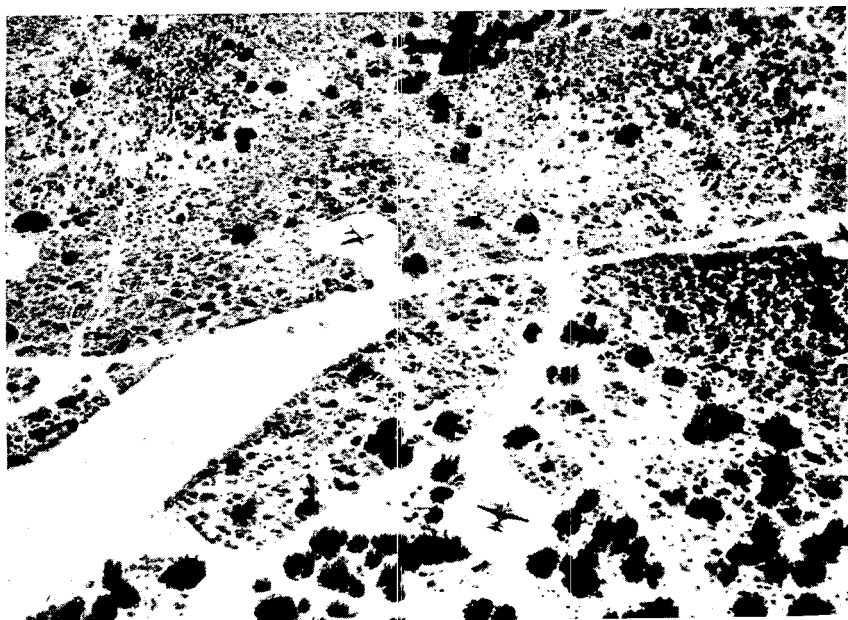


Figure 98. Oblique air view of decoy airfield installation.

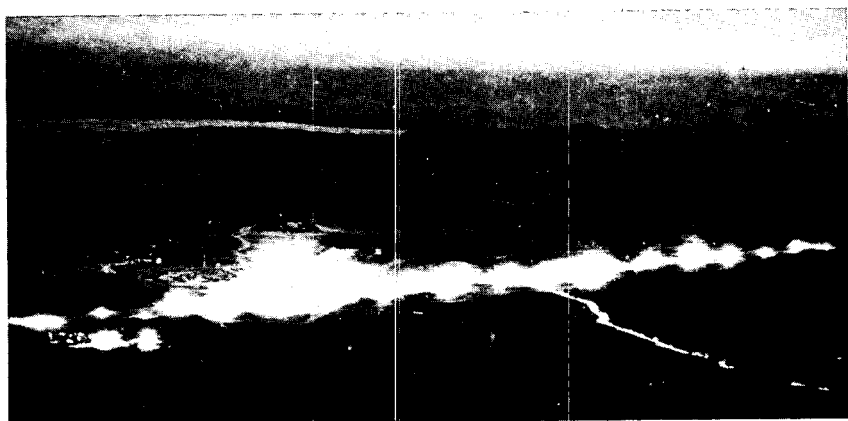


Figure 99. Air view, at night, of decoy airfield installation.

g. Decoy Obstacles. The construction of dummy or decoy obstacles such as road blocks, antitank walls and ditches, dragon's teeth, and simulated mine fields provides excellent means of deceiving the enemy. Siting of the decoy in relation to the position

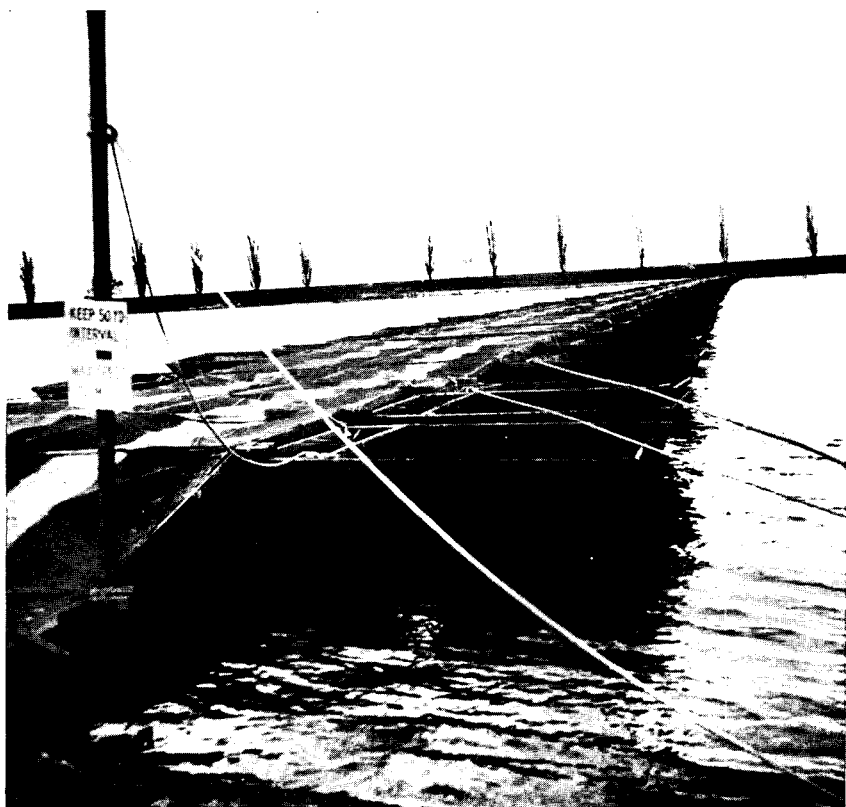


Figure 100. Decoy ponton bridge.

of the real obstacle must be carefully planned. Materials used should be of light, expedient construction to simulate as closely as possible the appearance of the real obstacle. Construction of dummy mines, dummy dragon's teeth, false brickwork and similar three-dimensional deceptive devices is described below. Figures 101 and 102 show two views of decoy dragon's teeth.

49. Construction of Decoys With Plastic Materials

Plastic materials, such as plaster, lime, cement, plaster of paris, native mud, clay, and many similar materials available commercially, are used in camouflage principally to construct decoys when it is necessary for three-dimensional form, a realistic appearance, and proof against close observation. Decoys made of plastic materials are employed in—

a. Operational Camouflage, which includes construction of decoys representing military installations, for example, pill boxes or dragon's teeth (fig. 101).

b. Protective Camouflage, which includes construction of, or

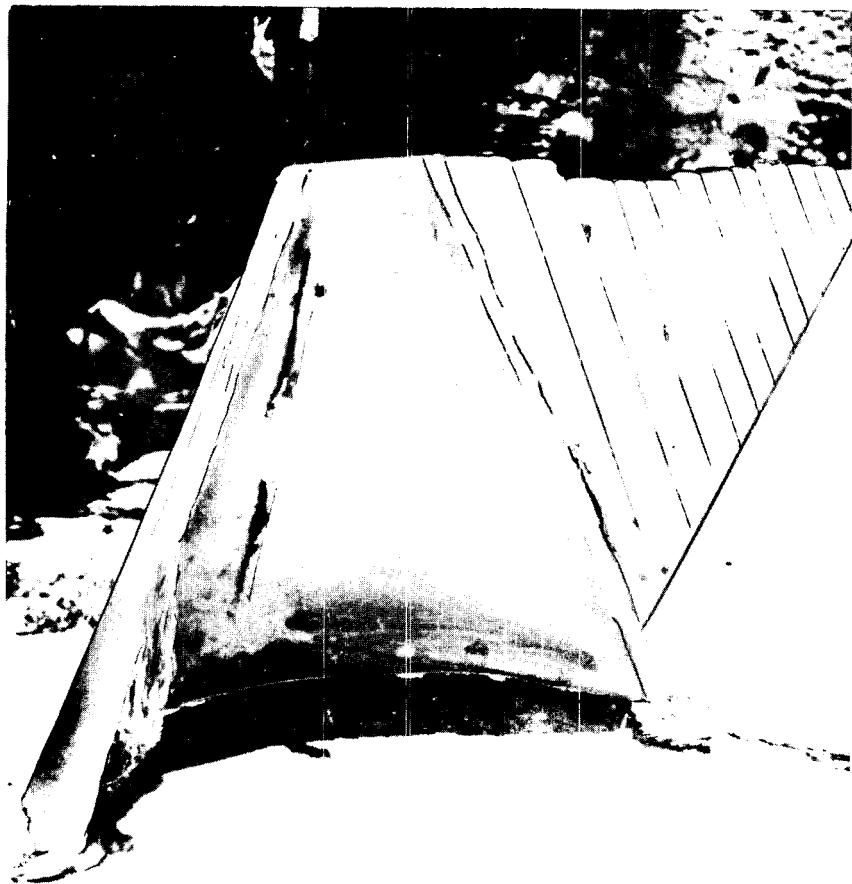


Figure 101. False plaster dragon's teeth.



Figure 102. Antitank obstacles of hollow plaster dragon's teeth.

additions to, civilian structures and terrain features such as hill-sides and rock out-crops (fig. 106).

50. Methods of Making Walls

The choice of construction methods discussed below is determined by the weather prevailing in the area involved, load expectancy simulated, and the height of the decoy and resistance to wind required.

a. Solid Walls by Use of Concrete Forms.

- (1) Construct a concrete wall form.
- (2) Mix a sufficient quantity of clay and cement or mud and cement in the proportions of 7 parts of clay or mud to 1 part of cement. In relatively dry areas where there is enough sun to bake the wall, adobe made only of clay, sand and water may be used. In other climates, adobe walls may be waterproofed by the application of bituminous emulsion to exposed surfaces. An approximately correct mixture for adobe is 10 cubic feet of a plastic clay, 10 cubic feet of sand, and 4 gallons of water.
- (3) To this mixture add straw, grass, or other fibrous reinforcing material plus a few handfuls of lime, and mix thoroughly.
- (4) If sandy earth is substituted for clay, change proportions to 3 parts of sand to 1 part of cement. In the absence of cement, use asphalt or similar adhesives.
- (5) Pour resulting mixture into the form and puddle it so that no air pockets remain.
- (6) Allow ample time for drying and remove form.

b. Light Framework Walls.

- (1) Construct a framework of vertical and horizontal supports to the desired dimensions and cover with plain chicken wire or wooden laths.
- (2) Mix moulding material as described above.
- (3) Apply thickly by hand all over the wire or laths.

c. Walls of Soil Blocks.

- (1) Mix moulding materials as described above.
- (2) Construct wooden moulds with a slight batter, 10 by 12 by 4 inches, 18 by 14 by 4 inches, or larger if necessary. It is also possible to make moulds by digging a level pit 4 inches deep in the ground, using greased or water-soaked boards for dividers.
- (3) Pour mixture into the moulds and compact thoroughly with a tamper which has about 8 square inches of tamping surface. Avoid the formation of layers.
- (4) Allow to dry or "bake" in the sun.

- (5) Remove moulds and allow blocks to harden until completely dry before using them as building blocks.
- (6) To cement blocks together, use a mixture similar to original moulding mixture.

d. Bituminous Stabilized Soil Blocks for Wall Construction.

- (1) The correct mixture must be determined by experimentation, as the ratio is affected by the type of clay available. One mix that has been used successfully is:
 - (a) 10 cubic feet of clay.
 - (b) 10 cubic feet of sand.
 - (c) 10 gallons of bituminous emulsion.
 - (d) 2 to 4 gallons of water.
- (2) After drying approximately 1 day, the blocks are set on edge to facilitate further drying. Four weeks are required before the blocks are ready for use.

e. Sod Blocks. Sod blocks cut from heavy native sod may be of value in some situations.

f. Walls of Burlap.

- (1) Construct framework to required size and cover with burlap or other coarsely woven fabrics.
- (2) Mix up plastic material to a consistency that will stick to the burlap but not run, and apply by hand.
- (3) After walls have dried, they may be painted if desired.

51. Moulding Forms

As indicated above, a rapid method of manufacturing complete objects or sections of complete objects is by moulds. Once a mould is prepared, a casting can be made in about 10 minutes. With two moulds working, 40 to 60 castings may be turned out in a day. Objects such as decoy land mines and rocks are a few of many which can be made in this way.

a. Materials for Constructing Mould.

- (1) Plaster of paris (powdered gypsum).
- (2) Animal or vegetable fibers.
- (3) Grease or sterolene.
- (4) Milled lumber of dressed timber.
- (5) Nails, assorted.
- (6) Burlap, osnaburg, or similar coarsely woven fabric.
- (7) Paint for spraying.

b. Construction of a Mould.

- (1) Select the object which is to be cast. The maximum practical overall size is 6 feet by 3 feet. Because of the weight, larger objects are made in sections and the casts joined afterwards. Do not attempt to take a mould of an object which has undercuts or "lips" which will prevent the removal of the mould from the object.

- (2) Coat object with oil, grease, or sterolene to minimize the chance of the mould sticking to the object. When taking a mould from a wall or any flat surface, enclose the area with a framework of light lumber (1, fig. 103).
- (3) Mix one bucket of plaster and water with three handfuls of fibrous material such as straw, grass, or leather or cloth strips. Vary the plaster and water to obtain a consistence of thick cream. Pour a layer of the mixture into the mould and trowel it until it just covers the surface. It is necessary to work speedily in order to prevent the plaster hardening before the surface of the object is covered. One man should do the mixing and two men the troweling. One and a half to two buckets of plaster cover an area of 6 by 3 feet.
- (4) Have burlap ready and cut to size. It should be slightly larger than the size of the mould so that all edges project a few inches. Dip it in water until it is saturated, then place it on the wet plaster. Press it on by patting with the hand until it adheres.
- (5) Apply another layer of plaster.
- (6) The plaster will have set sufficiently in 10 minutes for the frame to be removed. Some difficulty may arise in removing the mould, but if the edges are pried free with a chisel and pressure gradually brought to bear, the mould should come out readily.
- (7) For average sizes, the mould is prepared for use by placing it on a soft bed of burlap or by digging a hole and embedding the mould in the ground so that the exterior surface is supported. When such a hole is dug it should be made to conform generally to the shape of the mould so that the mould will be supported at many points along its surface. If a plaster cast in the form of a large rock is desired, the hole that is dug can be used for maximum support by constructing the mould in the hole as is shown in figure 104.
- (8) Paint the inside of the mould with oil paint. When dry, coat the inside with grease, and the mould is ready for use.

c. Plaster Casts From a Mould. (fig. 103).

- (1) Coat mould thoroughly with oil, grease, or sterolene.
- (2) Pour first layer of plaster and spread thinly, just covering the surface with a trowel.
- (3) Have burlap ready and cut to size. The edges should project on all sides. Saturate it with water and place on the plaster, patting it well into the plaster.

- (4) Pour in another layer of plaster and apply as before.
- (5) After drying, the casting is removed and painted on both sides to waterproof it. It then may be textured and colored as desired.

d. Papier Mache Casts From a Mould. This material requires more time than plaster, but is strong, durable, light in weight, and easily transportable.

- (1) Make a smooth liquid paste of flour and water, the consistency of heavy cream. The water and flour may be boiled together or water boiled separately and combined. Care should be taken to keep the paste from becoming lumpy.
- (2) Tear up any available waste paper, thin cardboard, or fabric into 5- to 7-inch squares.
- (3) Lightly oil or grease the mould.
- (4) Saturate each piece of paper or other material in the paste and then press it into the mould. Each piece is overlapped and pressed tightly to avoid air bubbles.
- (5) When one layer has been pressed into the mould, start the second and continue until 8 layers have been laid.
- (6) Allow about 1 hour for drying and remove from the mould. Place in an oven or direct sunlight until thoroughly dried.
- (7) Paint with shellac, varnish, or oleoresinous paint to waterproof the casting, then add any additional color coats, by spraying, until the desired effect is achieved.

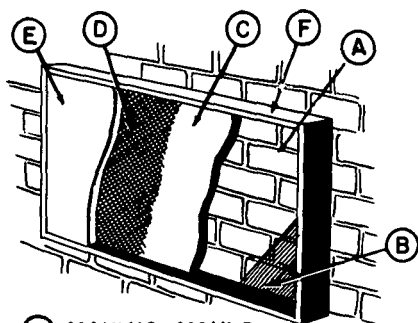
Figure 105 illustrates a simulated rock made by applying papier mache directly over a base of wire netting, without the use of a mold.

52. Simulating Terrain Features

The following methods are applicable to temporary or semi permanent installations in rear areas.

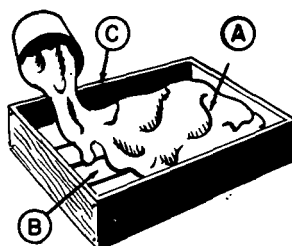
a. Simulated Rock Outcrops.

- (1) Construct a reinforced skeleton framework, of the required height, to conform with the configuration of the adjacent area (fig. 106).
- (2) Fasten a "sandwich" of alternate layers of chicken wire, burlap, and chicken wire to this framework.
- (3) Mix a plaster, without reinforcing material, of mud, clay, or sand.
- (4) Smear the mixture over the covered framework by hand, trowel, hoe, or improvised wooden spreader so that the final surface closely resembles the surface of real rocks in the area.



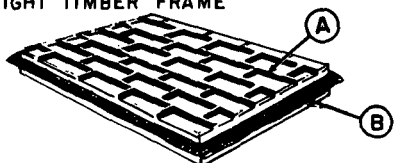
① MAKING MOULD

A-EXISTING WALL FROM WHICH MOULD IS TO BE TAKEN
 B-OIL OR GREASE ESSENTIAL
 C-FIRST LAYER OF PLASTER
 D-BURLAP
 E-FINAL LAYER OF PLASTER
 F-LIGHT TIMBER FRAME



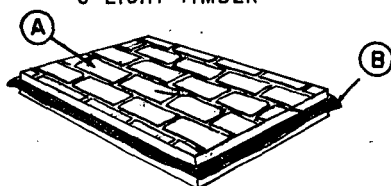
③ CASTING

A-FIRST LAYER OF PLASTER POURED OVER MOULD
 B- PLASTER MOULD
 C-LIGHT TIMBER



② COMPLETED MOULD

A- MOULD
 B- BURLAP PROJECTING BEYOND EDGE OF MOULD

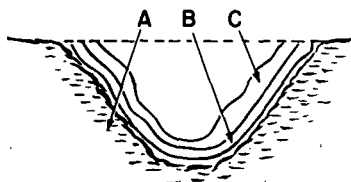


④ COMPLETED CAST SLAB

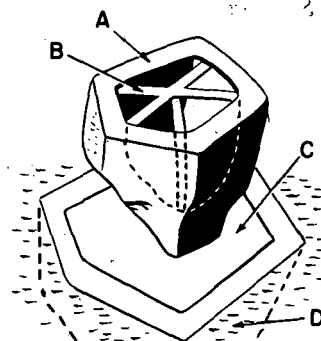
A-FINISHED SLAB
 B-BURLAP PROJECTING BEYOND EDGE OF SLAB

- 1 Making mould.
- 2 Completed mould.
- 3 Casting.
- 4 Completed cast slab.

Figure 103. Making a mould from an object and casting from the moulding.



A-GROUND
 B-BURLAP BETWEEN LAYERS
 C-MOULD DUG INTO GROUND



A-PLASTER CAST
 B-WOOD STRUTS REMOVED WHEN CAST IS DRY
 C-SUNKEN PLASTER MOULD
 D-GROUND

Figure 104. Making a mould in the ground.



Figure 105. A papier mache rock and a base of wire netting.

- (5) Immediately imbed local rocks, gravel, and sand in the wet plaster and paint in whole or in part as required.
- b. *Simulated Beach or Sand Dunes.*
 - (1) Construct a framework to conform to the undulating appearance of these areas.
 - (2) Mix up plaster consisting of soil or sand and any adhesive.
 - (3) Dip strips of burlap of convenient size into the plaster mixture.
 - (4) Immediately place the burlap on the ground, plaster side down, and pat its entire surface so that the underside picks up the sand, pebbles, shells, and other inorganic material beneath it.
 - (5) Fasten burlap to framework and slope loose sand against the lower edges to blend the edges with the background.



Figure 106. Simulated rock formation made of wire, burlap, and plaster. Note blending of simulated rock outcrop with actual terrain along dashed line in the figure.

GLOSSARY

Artificial—Fabricated, manmade, not natural.

Bituminous emulsions (also pigmented)—A mixture of asphalt or other bitumen in a liquid; when colored for various camouflage uses, it is called pigmented bituminous emulsion.

Blending—The arrangement of camouflage materials or an object with its background so that the object or the materials will tend to merge into and become indistinguishable from their background because of the lack of contrast.

Burlap—A coarse fabric made of jute, hemp, kenaf, or other coarse vegetable fiber.

Calcium chloride—A chemical used as a drying agent and for the laying of dust.

Camouflage clothing—Clothing, either colored, patterned, or both so that the wearer will blend with his background.

Camouflage face paint—Camouflage face paint is nontoxic to the skin and is used to tone down color of the face to make it less visible.

Cement, water paints—A colored water-soluble cement, the granules of which act as both binder and pigment.

Coir—Same as coconut fiber.

Color value—The degree of intensity of a color. The value of a color determines whether it is bright or dull.

Concealment—The application of camouflage techniques and materials to protect installations, equipment, or activities from enemy observation.

Debris—Rubbish, ruins; useful for concealment.

Deception—The planned ultimate perception by the enemy of a display of simulation or disguised equipment or both, and supporting ruses, which cause the enemy to react as though faced by real equipment or installation.

Deception operation—Any activity the aim of which is to draw attention; the use of any measure, the aim of which is to mislead by misrepresenting any installation, equipment or activity, i.e., the use of camouflage materials or measures to simulate or disguise a military object or activity so that the enemy will be

attracted to it and will be deceived as to its true nature or intent.

Decoy—A decoy is a camouflage weapon of deception and is a false military installation designed as a lure for the purpose of leading the enemy into some definite commitment of action or change of plan.

Dummy—A dummy is a weapon of deception designed to cause the enemy to disregard the installation as being of no useful military value.

Fabric—Cloth material of many different types. It is used in camouflage as a material for garnishing or screening.

Netting—A fabric of wire or twine, woven into meshes and used as supporting material for garnishing.

Nonsuspect—Displays no suspicious characteristics; no features worthy of further investigation as a source contributing to the furtherance of the enemy's war effort.

Oleoresinous paint—A paint with a mixture of oil and resin as the vehicle for the pigment.

Osnaburg—A strong, unbleached cotton fabric used as a substitute for burlap as a camouflage material.

Papier mache—A hard, strong substance made by mixing paper pulp with a paste or other suitable adhesive. It is useful for making simulated rocks and other moulded shapes in camouflage.

Pattern—Two-dimensional form or design.

Plastic materials—Materials capable of being shaped or moulded.

Screen—Concealment of an object by placing between it and its observer any other object which hides it from view.

Shape—The outward contour or outline of an object.

Simulated—Copied; made to look like the true or original.

Suspect—Displaying suspicious characteristics or features worthy of further investigation as a target.

Texture—The relative roughness or smoothness of a surface. Texture affects the tone of the surface since smooth surfaces reflect light better than rough surfaces.

Tone—The degree of lightness or darkness of any color including gray.

APPENDIX I

REFERENCES

DA Pam 108-1	Index of Army Motion Pictures, Television Recordings, and Filmstrips.
DA Pam 31 series	Military Publications.
SR 320-5-1	Dictionary of United States Army Terms.
SR 320-50-1	Authorized Abbreviations.
FM 5-20 series	Camouflage.
TB ENG 77	Construction of Field-Expedient Decoy Floating Bridges.
TF 5-961	Camouflage for All Arms (British Film).
TF 21-2097	Camouflage Principles.
TF 21-2099	Concealment of Vehicles.
TF 21-2100	Concealment of Bivouac.
FS 5-107	Use of Field Decoy Installations.
FS 21-6	Concealment Against Air Observation— Part I.
GTA 5-1	Concealment and Camouflage.
GTA 5-3	Camouflage, Series One.
GTA 5-4	Camouflage, Series Two.

APPENDIX II

COATING AND STAINING MATERIALS

Paint, Camouflage, Emulsifiable, Military Specification MIL-P-13340(CE) is the only field camouflage paint stocked by Engineer Depots. It is designed and procured for camouflage use on relatively nonporous surfaces for example metal, wood, stone, concrete and at a dilution of one volume of either water or dry solvent (gasoline, mineral spirits, etc.) to one volume of emulsifiable paste. The requirements of color, gloss, durability, etc. are based on such dilution. The emulsifiable paste may be diluted to the extent of three volumes of water to one part of paste and used in the resulting condition on fabric.

Other Federal or Military specification paints may be used for various surfaces as designated in the tables which follow.

Table I. Paint, Camouflage, Resin Oil Emulsion and Resin Emulsion Type Paste

Types available.....	Ready-mixed in 1-and 5-gallon cans.
Colors available.....	FED SPEC TT-C-595
Source.....	MIL-P-18358 (Docks)
Recommended uses.....	Wood. Primer (table XI) should be used when a more permanent coating is desired.
	Primed metal. Rubber.
Durability.....	Good-excellent protection from weathering.
How prepared.....	Miscible with water or mineral spirits.
How applied.....	Brushing.
	Spraying. Thin with equal volume water or one-half volume mineral spirits to 1 gallon of paint.
Drying time.....	About 24 hours.
Resultant surface.....	Flat finish.
How removed.....	Not practicable.
Climatic limitations.....	Not suitable for use in freezing temperatures. In cold climates dries slowly.
Coverage.....	See appendix IV.

Table II. *Paint, Camouflage, Emulsifiable*

Types issued.....	Paste, in 5-gallon cans, olive drab in 55-gallon drums also.
Colors available.....	Standard camouflage colors.
Source.....	MIL-P-13340 (C.E.): Light green. Dark green. Sand. Field drab. Earth brown. Earth yellow. Earth red. Olive drab. Black. White. Forest green. Desert sand.
Recommended uses.....	Primed wood, primed metal, Rubber.
Durability.....	Good about 12 months or more; does not wash off or chalk or fade excessively.
How prepared.....	Miscible with water or organic solvents such as kerosene, gasoline, mineral spirits, turpentine, and naphtha. 1 gallon of paint is reduced with 1 gallon of solvent. Paste or mixed paint must not be left in opened cans or volatile emulsifier will evaporate, making paint incapable of emulsifying.
How applied.....	Spraying, brushing.
Drying time.....	On wood and metal: not over 6 hours.
Resultant surface.....	Flat and lusterless.
How removed.....	Not practicable.
Climatic limitations.....	Paste will not freeze (stable at temperatures from -40° F. to 160° F.). When reduced with gasoline or naphtha, it may be used in subzero temperatures. Low temperatures do not prevent its drying, although it takes longer. May be applied under cold, damp conditions. Impervious to rain once paint film is dry.
Coverage.....	See appendix IV.

Table III. *Paint Protein-Binder, Cold-Water*

Types available.....	Powder, usually issued in 5-pound pasteboard containers. Paste, available in 5-gallon containers weighing about 50 pounds.
Colors available.....	FED SPEC TT-C-595.

Table III. Paint Protein-Binder, Cold-Water—Continued

Source.....	FED SPEC TT-P-22-powder. FED SPEC TT-P-230-paste.
Recommended uses.....	Fabrics-paste form has better penetration. Other surfaces only when need for color is temporary.
Durability.....	Poor—except under very favorable weather conditions, only slightly water-resistant, not washable, chalks and lightens in color, and in sunlight forms a brittle film.
How prepared.....	Miscible with water. POWDER. Reduce in proportions of 10 pounds of powder to 1 gallon of water. Must be used immediately after mixing. PASTE. One gallon of paste is mixed with 1/2 gallon of water to make about 1½ gallons of paint.
How applied.....	Dipping, spraying, brushing.
Drying time.....	Must set for 48 hours before it becomes even slightly rain-resistant. Dries to touch in 30 minutes to 2 hours and dries to handle within 6 hours (both types).
Resultant surface.....	Hard, flat surface.
How removed.....	Scrubbing with scrub brush soaked in water and ammonia or soap.
Climatic limitations.....	Paste form must be protected from freezing while in storage, but can be used after thawing. Neither form can be used in freezing temperatures.
Coverage.....	Paste type in storage under conditions of heat is likely to decompose and become unusable. See appendix IV.

Table IV. Paint, Paste, Lusterless, Gasoline Removable

Types issued.....	Paste, in 1-gallon cans.
Colors available.....	Only white readily available from engineer depots. Commercially available in all colors.
Source.....	MIL-P-13983
Recommended uses.....	Previously coated surfaces—for application of non-permanent coatings, such as identification marks or patterns on vehicles, guns, aircraft, and equipment. Paint is readily removable with gasoline. Blackout purposes.
Durability.....	Not suitable for canvas, unpainted wood, or metal. Impermanent—durable for approximately 2 months.

Table IV. *Paint, Paste, Lusterless, Gasoline Removable*—Continued

How prepared.....	Miscible with gasoline or mineral spirits to consistency desired. Should be stirred vigorously. After gasoline is added, 1 to 2 hours are required to dissolve powder in solvent before paint is ready for use. Nine pounds of powder to 1 gallon of solvent make 1½ gallons of paint. For field measuring, one 5-gallon can of powder may be mixed with 2 gallons of solvent. Do not use near open flame or in a closed room because of fumes and inflammable nature of this paint.
How applied.....	Brushing, spraying.
Drying time.....	15 to 60 minutes.
Resultant surface.....	Flat.
How removed.....	Scrub brush or rag soaked in gasoline.
Climatic limitations.....	Excellent for use in freezing temperatures.
Specification.....	Corps of Engineers Tentative Specification No. T-1227.
Coverage.....	See appendix IV.

Table V. *Cement Water Paints*

Types available.....	Type I. Powder, cement. Type II. Protein, powder, modified cement. Type III. Oil paste, modified cement.
Colors available.....	This material cannot be obtained in dark camouflage colors. Available only in a range of light colors.
Source.....	FED SPEC TT-P-21.
Recommended uses.....	POWDER. If not subject to abrasion, use on: Tile, brick, masonry, concrete, stucco, plaster, except gypsum plaster. <i>Note.</i> Not recommended for wood or bituminous surfaces; or for runways, roads, or other traffic-bearing surfaces. PASTE. Galvanized iron. Primed metal.
Durability.....	Good—does not powder, chip, or rub off. The cement acts as both a pigment and binder.
How prepared.....	Miscible with water in equal volumes.
How applied.....	Brushing. May be used with some types of heavy-duty spray equipment.
Drying time.....	30 minutes to 6 hours.
Resultant surface.....	Hard, opaque, flat, lusterless.
How removed.....	Not practicable.
Climatic limitations.....	Cannot be applied in freezing temperatures.
Coverage.....	See appendix IV.

Table VI. Oil Type Paints for Runways

Types available.....	Ready-mixed.
Colors available.....	White and yellow.
Source.....	TT-P-115a (Traffic). Can be made to order with camouflage colors, but is not made so commercially.
Recommended uses.....	Concrete and bituminous surfaces exposed to abrasive effects of traffic.
	Asbestos.
	Wood and wood chips.
	Composition tiles.
Durability.....	Excellent—but dependent on amount of wear.
How prepared.....	Ready for application. If necessary, can be thinned either with mineral spirits or turpentine—1 gallon paint to $\frac{1}{4}$ gallon gasoline or V.M. & P. naptha.
How applied.....	Spraying. Brushing. Asphalt distributor.
Drying time.....	Less than 1 hour.
Resultant surface.....	Flat. (Must be specified.)
How removed.....	Not practicable.
Climatic limitations.....	Should not be applied to wet or damp surface.
Coverage.....	See appendix IV.

Table VII. Paint, Camouflage, Bituminous-Emulsion, Adhesive

Types issued.....	Ready-mixed in 55-gallon drums.
Colors available.....	Dries to a blackish-brown.
Source.....	Mil-P-3840
	Commercial.
Recommended uses.....	Stabilized earth. Earth, cinders, gravel.
	Concrete Prime coat for pigmented
	Surfaces previously bituminous emulsion.
	coated with bituminous May be used on damp
	materials. surfaces.
Durability.....	Impermanent—but since it is inexpensive, it may be desirable to recoat rather than use a more expensive material initially. For ground painting, a prime coat is recommended.
How prepared.....	Miscible with water. To prepare, add 4 times its volume of water. If a wetting agent (2 percent by weight of tetrasodium pyro phosphate) is added, better penetration results.
How applied.....	Spraying. Brushing. Asphalt distributor.
Drying time.....	Dry to touch in 8 hours.
Resultant surface.....	Medium gloss, which dulls rapidly on exposure.
How removed.....	By burning. Apply layer of fine sand 2 to 3 inches deep over surface to be removed; saturate with gasoline; ignite; remove residue with stiff brushes or scrapers.

Table VII. Paint, Camouflage, Bituminous-Emulsion, Adhesive—Continued

Climatic limitations.....	Freezing breaks down the emulsion and renders the material useless. May crawl or wrinkle in cold weather.
Coverage.....	See appendix IV. <i>Note.</i> Not recommended for use on runways used by jet aircraft. Melts under jet blast and causes following planes to skid. Sometimes flames.

Table VIII. Cutback Asphalt

Types issued.....	Type I. Slow Cure (S.C.) Type II. Medium Cure (M.C.) Type III. Rapid Cure (R.C.), in 55-gallon drums.
Colors available.....	Dark brown to black.
Source.....	Issue: Commercial.
Recommended uses.....	S.C. for dirt, cinders, gravel; has deep penetration. M.C. for concrete and dirt. R.C. for concrete and dirt. When applied to concrete, surface must be absolutely dry.
Durability.....	Good—dependent on growth of vegetation through coating when applied on earth.
How prepared.....	Type I (S.C.) is thinned with diesel oil. Type II (M.C.) is thinned with kerosene. Type III (R.C.) is thinned with gasoline.
How applied.....	Asphalt distributor. Spraying. Brushing.
Drying time.....	Variable, but quick drying.
Resultant surface.....	Mat.
How removed.....	By burning. Apply layer of fine sand 2 to 3 inches deep over surfaces to be removed; saturate with gasoline; ignite; remove residue with stiff brushes or scrapers.
Climatic limitations.....	None.
Coverage.....	See appendix IV.
Substitute.....	Coal tar may be used as a substitute for cutback asphalt.

Table IX. Primer, Enamel Undercoater, Phenolic

Types issued.....	Ready-mixed in 1-and 5-gallon containers.
Colors available.....	Dull red, yellow.
Source.....	Issue: Fed Spec TT-P-636 (Yellow) Commercial.
Recommended use.....	Primarily as a primer for ready-mixed, oil type paint applied to hard or absorbent wood surfaces, either vertical or horizontal.

Table IX. Primer, Enamel Undercoater, Phenolic—Continued

Durability.....	Good.
How prepared.....	Stir with paddle.
How applied.....	Brushing. Spraying.
Drying time.....	Dries hard enough to recoat within 24 hours (50° to 90° F.).
Climatic limitations.....	Not suitable for subfreezing temperatures.

Table X. Camouflage Face Paint

Types issued.....	Stick form. Divided into 2 camouflage colors in cylindrical metal container. It contains an insect repellent which is effective from 4 to 6 hours. It is nontoxic.
Colors available.....	Light green and loam for white troops. Light green and sand for colored troops. White and loam for troops operating in snow.
Recommended use.....	Toning down and patterning face and hands of soldier for protective concealment in combat.
Durability.....	Good—not affected by perspiration, will not rub off from contact with brush and grass, or wash off by immersion in water.
How prepared.....	Ready for use.
How applied.....	Rub stick over face and hands.
Resultant surface.....	Dull, opaque film.
How removed.....	With soap and water.
Climatic limitations.....	Suitable for use at temperatures of 20° to 150° F.

Table XI. Stains for Wood Surfaces

Types issued.....	Type I. Oil stains, ready-mixed. Type II. Asphalt stains, ready-mixed. Type III. Creosote stains, ready-mixed.
Colors available.....	Nonstandard color range; variable with manufacturer.
Source.....	Commercial.
Recommended uses.....	New wood. Previously stained surfaces.
Durability.....	Fair—fair color permanence. Type III has a limited preservative effect on wood.
How prepared.....	Ready for application, but may be thinned with mineral spirits or turpentine.
How applied.....	Brushing. Spraying. Asphalt distributor.
Drying time.....	About 8 to 12 hours.
Resultant surface.....	Flat. Type I may be painted over with any other type of coating. Type II cannot be painted over since the asphalt will bleed through.
How removed.....	Not removable.
Climatic limitations.....	None.
Coverage.....	See appendix IV.

Table XII. Tone-Down Materials for Use on Concrete

No.	Coating material	Obtainable in—	Available colors	Source	Durability	Preparation	Drying time in hours	Limitations
1	Cutback asphalt (coal tar may be used in lieu of asphalt).	55-gal. drums.	Brownish-black only.	*Commercial and Fed. Spec. SS-A-671.	Good.	Ready-mixed in 3 kinds: quick dry, medium dry, and slow dry.	(Med) 24.	Requires dry surface and conditions. May be used at sub-freezing temperature.
2	Bituminous emulsions—Class A.	55-gal. drums.	Brownish black only.	Commercial and Mil. Spec. MIL-P-3840.	Good except in hot-wet areas.	Ready mixed. Thinning not practical.	48.....	Can be applied to damp surface. Air temperature must be above 45° F. No good in tropics.
3	Camouflage pigmented bituminous emulsions.	55-gal. drums, liquid.	All camouflage colors except white.	Commercial (CE).	Fair (chalks rapidly).	Can be thinned with water up to 2 water/1 paint by volume.	4 to touch 48 to resist hard rain.	Old type-unfit to use after once frozen. New type—no restrictions. Can be applied to concrete.
4	Oleoresinous paint emulsifiable.	5-gal. can, paste form.	All camouflage colors.	Commercial and CE depot Spec. MIL-P-13340.	Fair.....	Must be thinned with gasoline or water, 1 to 1 by volume. Use gas or naphtha below freezing.	6.	Can be applied to damp surface. Good between -40° and +160° F.
5	Pigmented sodium silicate (water glass).	Varies	All camouflage colors.	Commercial only.	Good on rough surface poor on smooth.	Concentrate thinned with water is sprayed on surface followed by spraying with calcium chloride to set or fix.	-----	Can be applied to damp surface.
6	Camouflage oil-base runway paint.	Varies.	All camouflage colors.	Commercial.	Excellent for traffic surface.	Ready for application (may be thinned some).	1.....	Dry clean surface required.
7	Xylene and tar (Rt 2). Kerosene and asphalt (similar to British pitch and creosote mix).	Varies.	Brownish-black only.	Commercial.	Fair.....	Mix 80 tar to .20 xylene. Mix 25 asphalt to 75 kerosene by volume.	(Rapid).	Dry clean surface required.

*By "Commercial" it is meant that the material has no specification, but can be made up in camouflage colors commercially.

Application methods	Coverage	Thinners	Fire hazards during application	Effects of jet exhaust at warm-up points	Suitable texturing materials	Remarks
Brushing, spraying, tank distributor.	25 to 90 sq. ft. per gal.	Quick gasoline. Medium-kerosene. Slow-diesel fuel.	High during application. If coating is heavy, it will support combustion if fired by jet exhaust or other means.	Melting increases shininess and slipperiness. Possible fire.	Gravel; slate chips. Wood chips where time not a factor.	Not recommended for surface exposed to jet exhaust.
Brushing, spraying, tank distributor.	25 to 90 sq. ft. per gal.	None.....	Low.....	Will remove. Better than cutbacks (1) but has same drawbacks.	Asphalt chips, rubber chips, wood chips, other small granules.	Surfaces coated with bituminous emulsions cannot later be painted with lasting success with any other types of paint.
Brushing, spraying, tank distributor.	300 to 350 sq. ft. per gal.	Water.....	Low.....	Same as above.	Small granules only.	Recommend use of class A (2 above) for prime coat.
Brushing, spraying, tank distributor.	450 to 600 sq. ft. per gal.	Water, gasoline and naphtha.	High with gasoline and naphtha. Low with water thinner.	Will remove but will not support its own combustion.	None. Will not bind.	Appears to be best for purpose where jet exhaust precludes 1, 2, and 3, above.
Spraying, tank distributor.	Not available.	Water.....	None.....	Probably will remove, but no time hazard at all. Color change effects unknown.	None.....	Good for limited types of surface. Traffic on smooth surface pulverizes brittle coating which then blows up, washes off.
Spraying, and tank distributor (liner).	300 to 350 sq. ft. per gal.	Turpentine, gasoline, VM&P naphtha.	Medium to high.	Will blister and change color.	None.....	Best except very costly.
Spraying, and tank distributor.	Not available.	Xylene kerosene.	High.....	Will remove. No fire hazard with thin film, may be with thick film.	None.....	Primarily a cheap stain. Has application and fire drawbacks.

Table XIII. Field-Expedient Tentage Stain No. 1

Type issued.....	Field expedient.
Colors available.....	Dark gray.
Source.....	Manufacture by troops.
Recommended use.....	Tentage.
Durability.....	Fair.
How prepared.....	BILL OF MATERIALS: Local earth. Soot. G.I. or field-expedient Paraffin. soap. Water. PROCEDURE: Mix local earth with soap solution in proportion of $\frac{1}{2}$ pound of soap to 8 gallons of water in which soot soaked in a little paraffin has been added. Enough soot is used to form a liquid possessing the desired tone of gray.
How applied.....	Brushing. Swabbing with a rag.
Drying time.....	Variable, but fairly rapid.
Resultant surface.....	Flat, lusterless.
How removed.....	Not practicable.
Climatic limitations.....	Not recommended for freezing temperatures.

Table XIV. Field-Expedient Tentage Stain No. 2

Type issued.....	Field expedient.
Colors available.....	Dark grey.
Source.....	Manufacture by troops.
Recommended.....	For faded or undyed tentage.
Durability.....	Good. Rain washes off stain to some extent.
How prepared.....	BILL OF MATERIALS: Charcoal. Water. PROCEDURE: Obtain charcoal by burning scrap lumber and crushing the residue as fine as possible. Mix this charcoal with water to desired tone.
How applied.....	Swab on with a rag.
Climatic limitations.....	Not recommended for freezing temperatures.

Table XV. Fabric Dye

Type issued (Supply Manual QM 5-68).	Dye, in liquid form, in 1-gallon container. Dye, in powder form, ordered by the pound.
Colors available.....	Issue: Aniline blue (liquid). Aniline bright yellow (liquid). Aniline red (liquid). Methyl violet (powder). Dark blue (powder). Seal brown (powder). Eerie blue-green (powder). Commercial: All colors.

Table XV. *Fabric Dye*—Continued

Source.....	Quartermaster Corps. (Dyes normally not stocked, but authorized for local procurement when needed.)
Recommended uses.....	Dyeing or redyeing underwear, handkerchiefs, socks, towels, mosquito bars, uniforms, and webbing.
Durability.....	Good. Colors will fade gradually with repeated laundering.
How prepared.....	BILL OF MATERIALS: Dye. Pail. Water. Common salt (substitute: sea water). Scale. Messkit spoon. Standard metal laundry washer (provided temperatures of at least 160° F. can be obtained; wooden laundry washers must not be used). PROCEDURE: For 20 pounds of dry articles to be dyed, proportions are: 24 gallons of water, 2 pounds of salt, 1½ ounces (2 rounded messkit spoonfuls) of powder dye or 1½ fluid ounces (2 messkit spoonfuls) of liquid dye. Weigh dry articles to be dyed. Limit to be placed in laundry washer is approximately ½ its rated capacity. Add hot water (about 120° F.) to prescribed level. Add salt and run for 5 minutes. Dissolve dye in a pail of nearly-boiling fresh water, stirring well to obtain complete dissolution. Slowly add to the turning laundry wheel. Turn on steam and raise temperature at least to 160° F. for 15 to 20 minutes. Turn off steam and operate for 15 to 20 minutes. Drain water. Rinse twice for 3 to 5 minutes in cold water. Remove articles and dry. After dyeing, the laundry wheel must be thoroughly cleansed with hot water and bleach solution and rinsed before being used for washing clothes. Procedure in open kettle: G.I. can (32 gallons) is placed over a trench fire. Fill ¾ full of water and heat to 120° F. Add 2 pounds of salt. Add 20 pounds of articles and stir for 3 to 5 minutes. Dissolve dye as described above and add slowly, stirring constantly. Continue heating and stirring for 30 minutes at near boiling point. Rinse and dry.

Table XVI. Canvas Refinishing Compound

Types issued.....	Type I. Water-, weather-, and mildew-resistant; ready-mixed in 1-gallon cans and 55-gallon drums. Type II. Water-, weather-, mildew-, and fire-resistant; ready-mixed in metal drums.
Colors available.....	Color A. Dark olive drab (olive drab No. 7). Color B. Olive drab. Color C. Green. (Any other color may be requisitioned from Quartermaster Corps by a major unit commander.)
Source.....	Issue: Quartermaster Corps and Corps of Engineers.
Recommended uses.....	Fabrics—for coloring or recoloring: Tentage. Duck. Canvas. Clothing.
Durability.....	Good.
How prepared.....	By stirring. Gasoline may be used as a diluting agent if needed.
How applied.....	Place on flat surface and apply by: Rubbing. Brushing with stiff paint or scrubbing brush. Since compound is inflammable, do not apply in presence of flames or cigarettes.
Drying time.....	At least 2 hours are required before article is ready for use.
Resultant surface.....	Mat finish.
How removed.....	Not practicable.
Climatic limitations.....	Suitable for all climates.

Table XVII. Paint, Emulsified, Field-Expedient

Types.....	Field expedient—2 types.
Colors available.....	Dependent upon range of earth colors procurable.
Source.....	Manufacture by troops.
Recommended uses.....	Dust layer for earth—surfaced runways. Fabrics. Wood, but only where rainfall and abrasion are at a minimum. Concrete: fairly satisfactory. Metal: unsatisfactory resistance to rain and abrasion.
Durability.....	Satisfactory—for short periods. Fair durability of color and film properties on fabric; poor adhesion and abrasion resistance on wood and metal.

Table XVII. *Paint, Emulsified, Field-Expedient—Continued*

How prepared.....	TYPE I. BILL OF MATERIALS: Crankcase oil-salvage or waste. Water. Ground clay or powdered carbon. Pigmented soil. Gasoline for thinning. PROCEDURE: Two gallons of water are mixed gradually with 1 gallon of used crankcase oil and $\frac{1}{2}$ to $\frac{1}{4}$ gallon of ground clay. Screened pigmented soil is added to give desired color. This mixture is thinned to the right consistency with gasoline or mineral spirits. TYPE II. BILL OF MATERIALS: G.I. or field-expedient soap. Crankcase oil-salvage or waste. Water. Clay or diatomaceous earth. Pigmented soil. PROCEDURE: One and one-half bars of G.I. soap or an equivalent quantity of field-expedient soap (table XX) are dissolved in 3 gallons of water. Resultant solution is added gradually to 1 gallon of used crankcase oil, stirring constantly. One gallon of ground clay is then slowly stirred in and enough screened pigmented soil is added to give desired color.
How applied.....	Dipping—for fabric. Brushing—not very satisfactory. Spraying—not very satisfactory.

Table XVIII. *Field-Expedient Soap (for Field-Expedient Paint)*

Type.....	Field expedient.
Source.....	Manufacture by troops.
Recommended uses.....	To be used as substitute for G.I. soap in manufacture of field-expedient paint as described in table XIX.
How prepared.....	BILL OF MATERIALS: Waste grease from mess kitchens. Wood ashes. PROCEDURE: Burn hard wood and collect the ashes. Make a sieve from a large tin can by punching holes in the bottom. Place ashes in bottom of this can and pour water into it. Collect the water passing through, which is, in fact, a lye. Heating waste grease and lye together will result in a soap.
How used.....	This soap is dissolved in water and used to emulsify used crankcase oil to make an emulsified oil as described in table XIX.

Table XIX. Raw Molasses (for Field-Expedient Paint)

Type.....	Field expedient.
Colors available.....	Brown.
Source.....	Commercial sugar refineries; practicable only in areas where crude molasses is plentiful.
Recommended uses.....	Lay dust. Tone earth, as on runway. In extreme emergency, as an adhesive.
Durability.....	Unstable, not waterproof.
How prepared.....	Use as supplied.
How applied.....	Thin with water; the more water, the less adhesion. Asphalt distributor. Brushed with broom. Mobile spray equipment.
Drying time.....	May be covered with thin coating of local earth.
Coverage.....	Never dries; always sticky. 5 to 20 square feet per gallon.

Table XX. Used Crankcase Oil (for Use as Field-Expedient Paint)

Type issued.....	Salvage.
Colors available.....	Brownish.
Source.....	Motor pools, air bases.
Recommended uses.....	To tone down concrete. To lay dust. To tone down stabilized soil. To tone down soil around entrenchments.
Durability.....	Fair.
How prepared.....	Ready for application. May be mixed with native colored earths by hand or in motor-driven mixer.
How applied.....	Spraying, asphalt distributor.
Climatic limitations.....	May be applied under any weather conditions.
Coverage.....	See appendix IV.

Table XXI. Asphalt Cement

Availability.....	Source: Commercial.
Preparation.....	Ready-mixed.
Use.....	For staining surfaces on which applied: Concrete Bituminous
How applied.....	Asphalt distributor. Brushing.
Coverage.....	0.1 to 0.3 gallon per square yard.
Climatic limitations.....	Lowest atmospheric temperature for application, 45° F.
Durability.....	Good.
Time before surface can be used.	30 minutes.

Table XXII. *Field-Expedient Green Vegetation Adhesive*

Availability-----	Source: Field-expedient adhesive obtained in small quantity from practically any green vegetation.
Preparation-----	BILL OF MATERIALS: One or more 5- or 10-gallon metal buckets. One G. I. can or 55-gallon drum. PROCEDURE: Use only freshly-cut plant materials; otherwise the quality of the adhesives will be unsatisfactory. Twelve to fifteen 5-gallon bucketsful of vegetation yield about 1 gallon of dark-colored adhesive. Remove larger stalks and woody branches from the vegetation. Pack firmly into 5- or 10-gallon metal buckets until 2/3 full. Cover material with water to a depth of 2 or 3 inches. Boil over hot fire for about ½ hour until greater part of adhesive substances is extracted and a thin syrup is formed. Pour the thin syrup into a carrying bucket; discard spent material; repeat to this point as required. Pour contents of carrying bucket into a larger container, such as a G.I. can or empty gasoline drum and boil down to desired concentration. To avoid boiling over, this container is never more than half filled.
Use-----	Surfaces on which applied: Metal (as vehicles). Glass, wood, fabrics. <i>Note.</i> All surfaces must be free from oil and grease. This material is not capable of large-scale production and is suitable for use only on small areas.
How applied-----	With rags. With improvised brushes of dried grass stalks or pine needles.
Coverage-----	1,000 square feet per gallon on smooth nonporous surfaces. 400 to 500 square feet per gallon on rough surfaces.
Climatic limitations-----	Heat and cold have practically no effect on this adhesive. Fairly good weather resistance except under prolonged exposure to rain or high relative humidity.
Durability-----	Good bonding strength.

Table XXIII. *Field-Expedient Starch Adhesive*

Availability-----	Source: Wheat flour, ground grains. Whole grain, seeds, other hard grains. Potatoes, nonfibrous vegetables, fruits. Any other food that discloses presence of starch.
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Table XXIII. *Field-Expedient Starch Adhesive*—Continued

Preparation-----	When using flour or ground grains: Stir 1 part of flour into 4 parts of water by volume until no lumps remain. Heat and continue stirring until mixture becomes thick and smooth. Stir in water while cooling to reduce paste to right consistency. When cooking is out of the question, stir flour into cold water. When using whole grain, seeds, other hard sources: Add 4 to 5 parts of water by volume for each part of starchy materials. Boil until material softens and breaks up easily. Add-water to replace evaporation. Drain off excess water, mash remaining material, and stir until a smooth paste is formed. Hulls, bark, etc., may be removed by straining through burlap or coarse material. Stir in water to reduce to right consistency. When using potatoes and nonfibrous vegetables: Remove skins or outer coverings; place inner starchy parts in a cooking utensil or container. Add enough water to cover and cook until softened. Pour off excess water; mash remaining material thoroughly and stir to a smooth paste. Stir in more water to make paste the right consistency. If skins are not first removed, they can be strained out after mashing. When using fibrous materials, such as cassava, arrow-root, and sago palm: Grate material in improvised grater made by punching nail holes in a bucket cover. Mix grated material with twice its volume of water. Squeeze through a strong cloth. Repeat mixing and squeezing 3 times. Allow strained mixture to stand 2 or 3 hours until starch grains have settled to bottom. Adjust amount of water until it is about 6 times the volume of starch and cook over fire, stirring continuously until smooth, lump-free paste is formed. Add water if thinner consistency is needed.
Use-----	Surfaces on which applied: Wood, metal, fabric.
How applied-----	With rags. By hand or paddles.
	Improvised brushes of dried grass stalks or pine needles.
Coverage-----	Estimated: Smooth surfaces; 160-250 sq. ft. per gallon. Rough surfaces; 180-125 sq. ft. per gallon.

Table XXIII. Field-Expedient Starch Adhesive—Continued

Climatic limitations.....	Heat and cold have practically no effect on this adhesive. Tends to peel off smooth surfaces exposed to dry heat.
Durability.....	Excellent on rough surfaces. Good on smooth surfaces.

Table XXIV. Glue-Paste Adhesive

Availability.....	Field expedient for use in temperate climate.
Preparation.....	PROCEDURE: Add enough flour paste to a solution of glue sizing to thicken it. Then emulsify 3/4 gallon of resin-sizing varnish in a solution of 1/2 pound of borax and 2 gallons of hot water. The glue-paste solution is then mixed with the emulsion in equal proportions by volume to form the adhesive.
Use.....	Surface on which applied: This adhesive is recommended as an emergency substitute for bituminous-emulsion adhesive when applying texturing materials to chicken wire.

Table XXV. Adhesives and Suggested Granules

Adhesive	Types of granules suggested	Application of granules
Pigmented bituminous emulsion (table VI).	Medium-hard asphalt chips, 1/4-1/2 inch. Wood chips. Other similar granules. (table XXVI)	10 minutes after application of adhesive.
Asphalt cement (table XXIII).	Large size: Asphalt chips. Tanbark. Crushed rock. Wood chips. Coarse gravel.	Immediately after application of adhesive.
Cutback asphalt (table X).	Wood chips. Fine Gravel. Bagasse. Slate granules. Other similar small materials (table XXVI).	10 minutes after application of adhesive.

Table XXV. *Adhesives and Suggested Granules*—Continued

Adhesive	Types of granules suggested	Application of granules
Green vegetation, expedient (table XXIV).	(1) Adhesive with molasses consistency; use sand, soil, ashes, or wood litter. (2) With adhesive paste so heavy it will not run after it is applied; use leaves, grass, bark, twigs, or other heavier materials (table XXVI).	Immediately after application of adhesive. Apply heavy paste adhesive in small patches. The texturing material is pressed on each patch before the next one is applied.
Starch, expedient (table XXV).	Sand. Light colored soils. Other similar materials.	Immediately after application of adhesive. A second dusting just before drying is recommended to give more coverage. Where a heavier coating is needed, mix together the sand and adhesive into a thick paste, then spread on with hand or paddle, and finally dust over with dry sand while surface is still moist.
Glue-paste (table XXVI).	Chicken feathers, fibers, moss. Other similar materials. (table XXVI).	Immediately after application of adhesive.

APPENDIX III TEXTURING AND COVERING MATERIALS

Table XXVI. *Texturing Materials*

Textured material	Durability compared with rock chips	Abasion	Average light meter readings, vertical on bright sunny days	Coverage per ton in square yards	Sources	Remarks based on: 1. Abasion 2. Durability 3. Texture
Wood chips, 1".....	Percent	Low.....	25.....	800.....	Tanneries, wood pulp concerns, paper mills.	Very good.
Rock chips, 1/2".....	75.....	High.....	20.....	90.....	Quarries and road building contractors.	Very good.
Gravel.....	100.....	Medium.....	40.....	90.....	Gravel pits.....	Fair.
Leather chips.....	75.....	Low.....	30.....	115.....	Shoe and leather goods manufacturers.	Very good.
Coffee beans.....	75.....	Low.....	Not available.....	90.....	Coffee growers.....	Very good.
Wood cubes.....	60.....	Low.....	25.....	161.....	Lumber (cubes made on site).....	Fair.
Fabric (burlap scraps or similar materials).	30.....	Low.....	30.....	2,000.....	Rag and textile concerns.....	Good.
Plant mix, 1 1/4" open graded aggregate.	100.....	Medium.....	35.....	22.....	Asphalt distributors.....	Very good.
Slag.....	80.....	High.....	37.....	90.....	Iron and steel blast furnaces.....	Very good.
Pine bough tips.....	20.....	Low.....	25.....	400.....	Local labor.....	Fair.
Pine cones.....	20.....	Low.....	Not available.....	161.....	Local labor.....	Good.
Excelsior.....	30.....	Low.....	25.....	2,000.....	Wood pulp concerns.....	Very good.
Shredded coconut fiber (coir).....	15.....	Low.....	Not available.....	2,000.....	Byproduct of cocoa manufacturing.....	Good.
Redwood fiber.....	30.....	Low.....	30.....	1,600.....	R. R. round houses, boilers, factories.....	Good.
Cinders.....	90.....	High.....	Not available.....	90.....	Poultry slaughter houses, mattress manufacturers.....	Fair texture; good durability.
Feathers.....	15.....	Low.....	40.....	20,000.....	Cotton-gins.....	Fair.
Cotton seed hulls.....	50.....	Low.....	Not available.....	3,000.....	Local labor.....	Good texture; poor durability.
Spanish moss.....	10.....	Low.....	Not available.....	2,000.....	Paper mills, junk dealers.....	Excellent texture; poor durability.
Paper, shredded.....	05.....	Low.....	Not available.....	2,000.....	Lumber mills, furniture manufacturers, Plywood mills.	Good texture; poor durability.
Sawdust, 3/4".....	75.....	Low.....	Not available.....	3,000.....	Local labor.....	Poor texture.
Leaves and chopped palm fronds.	15.....	Low.....	Not available.....	2,000.....	Local labor.....	Fair texture; poor durability.
Seaweed.....	10.....	Low.....	Not available.....	2,000.....	Salvage depots.....	Fair.
Tin cans.....			Not available.....			Very good texture.

Note. These figures are approximate, for purpose of comparison and rough estimates.

Table XXVII. Nets, Twine

Nets, twine, ungarnished.

Mesh: 2¼ inches square.

Size (feet)	Weight (pounds)		Cubage (cubic feet)	
	Flat top	Drape	Flat top	Drape
15 x 15.....	4.0	4.0	0.3	0.3
14 x 29.....	6.7	6.7	.5	.5
22 x 22.....	8.1	8.1	.63	.63
17 x 35.....	10.0	10.0	.9	.9
29 x 29.....	12.2	12.2	1.1	1.1
36 x 44.....	24.0	24.0	1.8	1.8
45 x 45.....	34.0	34.0	2.5	2.5

Nets, twine, fabric, garnished

Issue.

Mesh: 2¼ inches square. Materials required

Size (feet)	Weight (pounds)		Cubage (cubic feet)		Number of garnishing strips 2" x 60"		Number of rolls 2" x 300'		Approximate man-hours	
	Flat top	Drape	Flat top	Drape	Flat top	Drape	Flat top	Drape	Flat top	Drape
15 x 15...	9	11.8	0.9	1.18	234.0	306	4	5	5	7-8
14 x 29...	12	15.8	1.0	1.31	422.0	550	7	9-10	14	19-20
22 x 22...	15	19.6	1.5	1.96	454.0	594	8	9-10	14-15	19
17 x 35...	20	26.2	2.0	2.6	617.0	808	10	13-14	19	25-26
29 x 29...	27	35.2	3.3	4.3	874.6	1142	14-15	19	30	40
36 x 44...	51	66.9	5.0	6.6	1645.0	2160	27	36	55	60
45 x 45...	60	78.5	6.0	7.9	2110.0	2760	35	46	60	62-63

Color percentages for garnishing with artificial materials.

Tropical and summer temperate	Winter temperate	Desert or arid areas	All-seasonal
70% dark green.....	60% earth brown.....	80% sand.....	60% dark green.
15% light green.....	30% olive drab.....	10% olive drab.....	40% earth brown.
15% field drab.....	10% earth red.....	10% light green.....	

The figures in this table are based on 65% garnishing for flat top nets and 85% garnishing on drape nets.

Table XXVIII. Netting, Camouflage, Wire, Steel

Type	Size	Weight (pounds)	Cubage (cubic feet)	Color
Galvanized, garnished with fabric (fig. 66)----- <i>Note.</i> Fabric garnished netting is less costly than other garnished nettings, but it lacks the durability of the others and is intended for use only where short term requirements of a few months exist.	6 x 150-foot rolls.	95-----	5.5	Dark green, desert sand, earth brown, field drab, forest green, light green, olive drab, sand.
Welded, garnished with steel wool (fig. 76)----- <i>Note.</i> Although bonderized to prevent rusting, in humid climates both steel wool and wire will rust and have short useful life.	6 x 75-foot rolls	100-----	6.4	Do.
Enameled, garnished with glass fiber (grass texture or foliage texture) (1 and 2, fig. 81). <i>Note.</i> Glass fiber should not be used over easily fouled equipment since it tends to splinter and chip when handled. However, it is superior in some respects to steel wool since it is more durable and does not use strategic materials. The glass fiber is enclosed between 2 layers of chicken wire, the upper being a light 6-inch hexagonal mesh.	6 x 75-foot rolls	About 100.	6.4	Do.
Garnished with feathers. <i>Note.</i> For field manufacturing techniques, see paragraph 26d	6 x 150-foot rolls.	-----	-----	Do.

Table XXIX. Wire, Steel, Carbon, Annealed, Zinc-Coated, 16-Gage

Issue (ENG 3-22)-----	Coils of 12 or 125 pounds. 12-pound coil approximately 1,150 feet; 125-pound coil approximately 12,200 feet.
Average tensile strength--	250 pounds (high 300 pounds, low 200 pounds).
Recommended uses-----	To join adjacent edges of nets. To fasten net edges to flat-top frames. To wire-in paths. To fasten natural or artificial garnishing to camouflage structures. For general camouflage purposes requiring a light pliable wire, where stretching is not a disadvantage. Not capable of withstanding strong wind pressure or heavy tensions.

Table XXX. Wire, Steel, Carbon, Annealed, Zinc-Coated, 10-gage

Issue (ENG 3-22)	Coils 12 pounds; length, approximately 240 feet.
Average tensile strength	1,050 pounds (high 1,790 pounds, low 650 pounds).
Recommended uses	For normal camouflage construction.

NOTES

Tensile strength is greatly impaired by kinks that cannot be straightened by hand.

A small cut or nick, such as may be made in tightening a wire by using a claw-hammer, reduces its strength at that point.

The strength of various splices indicates the following to be the most efficient in the order in which they are listed:

Telegraph-wrap with pliers, 4 full turns.

Square knot tied by hand. Elongation of the splice of from 4 to 8 inches may be expected.

Long-wrap by hand, 3½ full turns. Splice will unwind at less than 900 pounds.

Generally in stringing main supporting wires from 2 to 6 strands will be used depending on the length of the span.

Spans 10 feet to 30 feet generally require 1 strand.

Spans 30 feet to 60 feet generally require 4 strands.

Spans 60 feet to 80 feet generally require 6 strands.

Table XXXI. Marline and Tape

Issue	Marline, jute, tarred. Two-ply, 10-pound coil with an approximate minimum breaking strength of 110 pounds when new.
Recommended use	To mark paths; general utility where suitable.
Issue	Tape, cotton, general use; bleached; ¾ inch wide, 500-foot roll.
Recommended use	To mark access paths into installations from existing roads or paths

Table XXXII. Lasting Qualities of Cut Tropical Foliage

Plant name	Days in sunlight without water	Days in sunlight with water
Australian pine (Casuarina)	1-3	8-16
Coconut palm—leaves	3-6	4-8
Fishtail palm (Caryota)—leaves	3-6	4-8
Mangrove	½-1	½-1
Palo maria (Calophyllum)	3-6	8-16
Screw pine (Pandanus)	3-6	3-6

Table XXXIII. Lasting Qualities of Cut Hardwood Foliage

Hours in sunlight without water	Northeastern American plants	European plants
8 or more-----	Red oak group Maple Apple Blueberry Hawthorn	Maple Apple Hawthorn Privet
5-7-----	White oak group Beech Basswood (linden) Chestnut Lilac	White oak group Beech Linden Lilac
3-4-----	Birch Cherry Elm Alder Hickory Yellow poplar (tulip tree) Sycamore	Birch Cherry Elm Alder Ash Poplar Plane (sycamore)
0-2-----	Willow Black locust Ash Aspen (poplar) Butternut Walnut Sumac Elderberry	Willow Black locust Elderberry
Days in sunlight with water		
6 or more-----	Apple Hawthorn Lilac Blueberry	Apple Beech Hawthorn Lilac Privet
3-5-----	Red oak group White oak group Beech Chestnut Basswood (linden) Sumac	White oak group Maple Linden Cherry

Table XXXIII. Lasting Qualities of Cut Hardwood Foliage—Continued

Days in sunlight with water	Northeastern American plants	European plants
1-2-----	Maple Birch Cherry Hickory Alder Yellow poplar (tulip tree) Sycamore	Birch Plane (sycamore) Poplar Ash Alder
Less than 1-----	Elm Willow Black locust Elderberry Aspen (poplar) Ash Butternut Walnut	Elm Willow Black locust Elderberry

Table XXXIV. Vines Suitable for Camouflage in Temperate Climate

Common and botanical names	Uses and camouflaging qualities	Culture	Propagation	Height of growth
Actinidia. ¹ <i>Actinidia</i>	Covering flat-tops, wire fences; dense growth.	Prefers coolness, moisture, sun, or partial shade.	Seeding or layering.....	20 to 30 feet.
Dutchman's Pipe. ¹ <i>Aristolochia</i> .	Covers and hides or screens. Large foliage.	Grown in any soil with little care. Sun or shade.	Layering; cuttings.....	30 feet or more, 4 to 6 feet annually
Cinnamon Vine, Yam, or Chinese Potato. ² <i>Dioscorea batatas</i> .	Spreads rapidly over any support; dense foliage.	Easy: no care except to provide support.	Tubers or seeds.....	10 to 30 feet.
Moonflower. ³ <i>Calonyction aculeatum</i> .	Ideal where temporary screen or covering required rapidly.	Plenty of water and sunshine.....	Seeding (must be done carefully)...	30 to 40 feet in a single season.
Hop. ³ <i>Humulus</i>	Dense growth of foliage; must have elastic support or will pull itself out of ground.	Thrives in heat or drought; requires good soil, some care.	Seed in fall or early spring; takes 8 to 10 days to germinate.	20 feet in 3 or 4 weeks.
Honeysuckle. ³ ⁴ <i>Lonicera</i> .	Dense growth where desired; cover steep banks.	Any soil.....	Layering; cuttings.....	From ground cover to 30 feet tall; 18 to 20 feet annually after becoming well established.
Fleeceflower. <i>Polygonum</i> .	Cover walls of buildings, framework; must be trained on wires.	Any soil.....	Plants may be divided; root branches in soil; sow seeds as soon as ripe.	Attains 25 feet in short time.
Kudzu Vine, <i>Pueraria</i> ...	Wherever quick screen is desired....	Prefers heavy soil: withstands drought.	Division of tuberous roots; layering if soil is kept moist.	Often attains 50 feet in a single season after becoming well-established.
Bittersweet. ⁴ <i>Celastrus</i> ...	Cover walls, banks, rocky ground; tied to a stake. It may be grown to form a tree.	Very little care; almost any soil....	Cuttings of mature soft wood; layering; seeding.	3 to 10 feet.

¹ Does not die to ground.

² Tuberous roots.

³ Grown from seed each year; these will die after the freezing weather of late fall.

⁴ Evergreen; the leaves are not shed in winter.

Table XXXV. Relative Dimensions of Large Trees

Diameter of ball of earth (feet)	Approximate weight (pounds)	Diameter of trunk 12 inches above ground (inches)	Approximate height of tree (feet)	Approximate spread of tree (feet)
3.....	1,300	4	16	8
4.....	2,100	5	18	10
5.....	3,300	6	20	12
5½.....	4,400	7	22	14
6.....	6,000	8	24	16
6½.....	7,000	9	26	18
7.....	8,100	10	28	19
8.....	10,000	11	30	20
9.....	15,000	12	32	22
10.....	22,000	13	34	24
11.....	27,000	15	38	28
12.....	32,000	17	44	30
13.....	45,000	20	50	32

Table XXXVI. Feather Machine

Material	Size	Length	Number	Use
Lumber.....	2" x 6"	12' 2"	2.....	Top side frames.
	2" x 6"	2' 10"	4.....	Legs.
	2" x 6"	2' 8"	8.....	Diagonal braces.
	2" x 6"	3' 2"	2.....	Hopper posts.
	2" x 6"	6' 1½"	2.....	Top frame spreaders.
	2" x 6"	6' 5¾"	2.....	Bottom frame spreaders.
	2" x 6"	2' 6"	1.....	Tank, drain support.
	2" x 4"	6' 1½"	3.....	Bridging.
	2" x 4"	8' 6½"	2.....	Bottom side frames.
	2" x 4"	6' 9¾"	1.....	Compactor roller spreader bar.
	2" x 4"	1' 5"	2.....	Compactor roller sides.
	2" x 2"	1' 4"	2.....	Guides.
	2" x 2"	7' 0"	1.....	Feather agitator bar.
	1" x 8"	6' 5¾"	11.....	Hopper side and top.
	1" x 8"	1' 10¼"	2.....	Hopper ends.
	1" x 8"	1' 7"	2.....	Hopper ends.
	1" x 8"	1' 1"	2.....	Hopper ends.
	1" x 8"	0' 9¼"	2.....	Hopper ends.
	1" x 8"	1' 3½"	2.....	Tank sides.
	1" x 4"	6' 9½"	20.....	Table top.
	1" x 4"	1' 9"	2.....	Hopper top battens.
	1" x 4"	1' 8"	4.....	Hopper side battens.
	1" x 2"	6' 2½"	12.....	Adhesive tank.
	1" x 2"	1' 1"	1.....	Hopper crank arm.
Pipe.....	2"	2" to 1"	1.....	Reducer.
	2"	Short.	1.....	Nipple.
	2"		1.....	Coupling.
	2"	6' 10½"	1.....	Rerolling bar.
	2"	6' 4"	1.....	Tank guide bar.
	1½"	6' 7½"	1.....	Compactor roller bar.
	1½"	6' 8"	1.....	Netting roll axle.
	1½"	6' 0"	1.....	Tank roller.
	1"	90°	2.....	Elbows.
	1"		1.....	Drain pipe cap.
	1"	6' 4"	1.....	Tank roller axle.
	1"	1' 0"	1.....	Crank.
	1"	0' 8"	1.....	Crank handle.
	1"	0' 6"	1.....	Drain pipe.

Table XXXVI. Feather Machine—Continued

Material	Size	Length	Number	Use
Bolts and nuts.	3" x $\frac{3}{8}$ "	-----	1.....	
	7" x $\frac{1}{8}$ "	-----	1.....	
	5" x $\frac{3}{8}$ "	-----	2.....	
Sheet, galvanized iron.	24 gage..	84" x 36"	1.....	Adhesive tank.
Nails.....	8d.....	-----	5 lbs...	Container for excess feathers.
Hinges.....	-----	-----	3.....	
Canvas.....	-----	72" x 6"	1.....	
Box.....	-----	-----	1.....	

APPENDIX IV

COVERAGE DATA FOR CAMOUFLAGE AND COVERING MATERIALS

Notes on coverage tables. The tables which follow give data on the coverage of various kinds of paints, stains, dyes, and adhesives appropriate to the 15 different types of surfaces listed. The figures given are based upon gallons of un-reduced paint and average painting conditions with operators of average experience. However, the rate of coverage and speed of application will vary with the condition of the surface to be coated, the equipment used, the skill of operators, and prevailing weather conditions. For example, on a large-scale disruptive painting operation using spray equipment the unit doing the work estimated that 50 per cent of the paint consumed on the job was lost due to wind. For brushing, the figures are based on the use of a brush from 3 to 4 inches in width, unless otherwise stated under "Remarks." For spraying, figures are based on the portable paint spraying unit described in paragraph 50. When the mobile paint-spraying unit described in paragraph 51 is used, the coverage rate will remain approximately the same, but the spraying rate will be approximately $2\frac{1}{2}$ times faster. The figures on speed of application are those of actual application and do not include time used in mixing paint or cleaning equipment. The figures on road distribution are calculated on the use of the bituminous distributor, model described in TM 5-519-2, using a $\frac{1}{8}$ -inch nozzle and an 8-foot spraying bar with 2 men operating the distributor. For detailed information on preparation and application, refer to the appropriate table specified in the first column.

Table XXXVII. Asphalt, Macadam, Bituminous Surfaces, and Tar-Coated Roofing Paper

Coating material	Brushing		Spraying		Asphalt distributor		Remarks
	Coverage (square feet per gallon)	Man-hours (per gallon)	Coverage (square feet per gallon)	Man-minutes (per gallon)	Coverage (square feet per gallon)	Application speed (square feet per minute)	
<i>Paints</i>							
Oil-type runway paint; table VI.	300	3	350	7	350	28.000	First choice for traffic bearing surfaces. Not applicable for roofing paper.
Camouflage, bituminous emulsion, pigmented; table II.	300	3	350	7	350	28.000	Second choice for traffic-bearing surfaces. First choice for surfaces not subject to abrasion.
Camouflage, cleoresinous, emulsifiable; table II.	450	4 ½	600	12	(¹)	(¹)	Third choice for traffic-bearing surfaces. Second choice for surfaces not subject to traffic. Reduce with water.
<i>Adhesives</i>							
Bituminous emulsion, table VII.	45	½	45	2	45	3,600	Brushed with large stable broom.
Cutback asphalt; table XXVII.	30	½	30	2	30	2,400	Brushed with large stable broom.
Asphalt cement; table XXI.	50	1/10	(²)	(²)	50	4,000	Brushed with large stable broom.

¹Not practical.

²Not applicable.

Table XXXVIII. Burlap, Osnaburg, Clothing, Nets, and Drapes

Coating material	Dippings		Spraying		Remarks
	Coverage (square feet per gallon)	Man-minutes (per gallon)	Coverage (square feet per gallon)	Man-minutes (per gallon)	
<i>Paints</i>					
Camouflage cleoresinous emulsifiable, table II.	400	50	600	12	First choice. The figures for dip application are based on fabric impregnated by dipping and passing through 2 steel squeeze rolls, 4 ft. long.

Table XXXVIII. Burlap, Osnaburg, Clothing, Nets, and Drapes—Continued

Coating material	Dippings		Spraying		Remarks
	Coverage (square feet per gallon)	Man- minutes (per gallon)	Coverage (square feet per gallon)	Man- minutes (per gallon)	
Protein-binder, cold water paint, table III.	200	25	300	6	The figures for spray application are based on coloring 1 side of the fabric only. Reduce paint with water.
Field-expedient, emulsified paint; table XVII.	40	5	60	2	Second choice. Same as above. Third choice. Same as above.
<i>Stains and Dyes</i>					
Canvas refinishing compound; table XVI.	1	1	1	1	May be used to recolor clothing. Application is by rubbing or impregnation by brushing. Not designed for other materials listed in heading (clothing only).
Fabric dye; table XV	1	1	1	1	For use on clothing only.
<i>Adhesives</i>					
Field-expedient green vegetation adhesive; table XXII.	1	1	1	1	Emergency use over small area such as truck tarpaulins.
Field-expedient starch adhesive; table XXIII.	1	1	1	1	Same as above.

¹Not applicable.

Table XXXIX. Canvas and Duck

Coating material	Brushing		Rubbing		Remarks
	Coverage	Man-hours	Coverage	Man-minutes	
<i>Stain</i>					
Canvas refinishing compound; Table XVI.	1	1	1	1	Can be used on tentage and on clothing. See also tables XV and XVI for expedient stains for tentage tonedown.

¹Not available.

Table XL. Feather-Garnished and Mineral-Fiber-Garnished Netting

Coating material	Spraying		Remarks
	Coverage (square feet per gallon)	Man-minutes (per gallon)	
<i>Paints</i>			
Ready-mixed, oil-type paint; table I	350	4	Figures are based on coating one side of netting only.
Camouflage, clearesinous emulsifiable table II.	600	6	Same as above. Reduce with water.
<i>Adhesives</i>			
Glue-paste adhesive; table XXIV.	(¹)	(¹)	Emergency use if standard adhesives are not available for application of texturing materials to wire netting.

¹Not available.

Table XLI. Concrete, Stucco, Brick, Building Stone, Slate

Coating material	Brushing		Spraying		Asphalt distributor		Remarks
	Cover- age (square feet per gallon)	Man- hours (per gallon)	Cover- age (square feet per gallon)	Man- minutes (per gallon)	Cover- age (square feet per gallon)	Applica- tion Speed (square feet per minute)	
<i>Paints</i>							
Oil-type runway paint; table VI.	250	2 ¹ / ₂	300	6	300	24,000	First choice for traffic-bearing sur- faces. Fourth choice for surfaces not subject to traffic.
Camouflage oleo- resinous emul- sifiable; table II.	400	4	500	10	(¹)	(¹)	Second choice for traffic-bearing sur- faces. Fifth choice for surfaces not subject to traffic. Reduce with water.
Cement water paint, type III; table V.	300	3	350	7	350	28,000	First choice for surfaces not sub- ject to traffic. Not practical for traffic- bearing surfaces.
Cement water paint, type I; table V.	300	3	350	7	350	28,000	Second choice for surfaces not sub- ject to traffic. Not practical for traffic- bearing surfaces.

¹Not practical.

Table XLI. Concrete, Stucco, Brick, Building Stone, Slate—Continued

Coating material	Brushing		Spraying		Asphalt distributor		Remarks
	Coverage (square feet per gallon)	Man-hours (per gallon)	Coverage (square feet per gallon)	Man-minutes (per gallon)	Coverage (square feet per gallon)	Application Speed (square feet per minute)	
Field-expedient emulsified paint; table XVII.	50	½	50	2	50	4,000	Emergency use only. See table XIX.
<i>Stains</i>							
Cutback asphalt, types II, III; table VIII.	100	1	100	3	100	8,000	Expedient use only. Reduce with thinner to get desired color.
Used crankcase oil; table XXI.	50	½	50	2	50	4,000	Expedient use only.
Xylene and tar (RT-2); table XII.	180-225	2	180-225	6	180-225	6,000	
Kerosene and asphalt table XII.	180-225	2	180-225	6	180-225	6,000	
<i>Adhesives</i>							
<i>Note.</i> Not recommended for use on runways used by jet aircraft. Melts under jet blast causing planes to skid. Sometimes flames.							
Bituminous emulsion, table VII.	45	½	45	2	45	3,600	Brush with stable broom. A prime coat of the same adhesive should be applied prior to the finish coat at the following rates: Reduce one part of adhesive to 3 parts of water. 700 square feet per gallon. 500 square feet per gallon.
Cutback asphalt; table VIII.	30	1/20	30	2	30	2,400	
Asphalt cement; table XXI.	50	1/10	(¹)	(¹)	50	4,000	500 square feet per gallon.

¹ Not applicable.

Table XLII. Earth, Sand, and Stabilized Soil

Coating material	Spraying		Asphalt distributor		Remarks
	Coverage (square feet per gallon)	Man-minutes (per gallon)	Coverage (square feet per gallon)	Application speed (square feet per minute)	
<i>Paints</i>					
Camouflage, bituminous emulsion, adhesive; table VII.	100	3	100	8,000	
Cutback asphalt, types I, II, III; table VIII.	100	3	100	8,000	Reduce with thinner to get desired color.
Field-expedient emulsified paint; table XVII.	20	2	20	1,600	Emergency use only.
<i>Stains</i>					
Used crankcase oil; table XX.	20	2	20	1,600	
Raw molasses; table XIX.	(¹)	(¹)	(¹)	(¹)	Emergency dust layer and tone-down, 5 to 20 square feet per gallon.

¹ Not available.

Table XLIII. Glass

Coating material	Brushing		Spraying		Remarks
	Coverage (square feet per gallon)	Man-hours (per gallon)	Coverage (square feet per gallon)	Man-minutes (per gallon)	
<i>Paints</i>					
Ready-mixed oil type paint; table I.	500	5	600	12	If glass is set tightly in the frame, painting black is apt to cause cracking of the glass by the sun's heat.
Camouflage, olear-esinous, emulsifiable; table II.	600	6	750	15	Same as above.
Camouflage, gasoline-soluble; table IV.	500	5	600	12	For temporary use, as for blackout purposes.
<i>Adhesives</i>					
Bituminous emulsion, class A; table VII.	45	½	45	2	
Cutback asphalt; table VIII.	30	½	30	2	
Field-expedient green vegetation adhesive; table XXII.	(1)	(1)	(1)	(1)	Apply by swabbing with rags. This item impractical for large-scale production.

¹ Not applicable.

Table XLIV. Glass Fiber and Steel Wool

Coating material	Spraying		Remarks
	Coverage (square feet per gallon)	Man-minutes (per gallon)	
<i>Paints</i>			
Camouflage, oleoresinous emulsifiable; table II.	600	12	First choice.
Enamel, rust-inhibiting, olive-drab.	500	10	This is not a camouflage paint and is available in olive drab only. Its use is recommended as a basic coating where humid atmospheric conditions without its application would shorten the life of the netting. The figures for spray application are based on coloring one side of the garnishing only.

Table XLV. Grass

Coating material	Spraying		Asphalt distributor		Remarks
	Coverage (square feet per gallon)	Man-hours (per gallon)	Coverage (square feet per gallon)	Application speed (square feet per minute)	
<i>Paints</i>					
Camouflage bituminous emulsion adhesive; table VII.	100	3	100	8,000	
Cutback asphalt; table VIII.	100	3	100	8,000	Reduce with thinner to get desired color.

Table XLVI. Metal, Coated or Primed

Coating material	Brushing		Spraying		Remarks
	Coverage (square feet per gallon)	Man-hours (per gallon)	Coverage (square feet per gallon)	Man-minutes (per gallon)	
Ready-mixed oil type paint; table I.	500	5	600	12	First choice.
Camouflage, oleoresinous, emulsifiable; table II.	600	6	750	15	Second choice.

Table XLVI. Metal, Coated or Primed—Continued

Coating material	Brushing		Spraying		Remarks
	Coverage (square feet per gallon)	Man- hours (per gallon)	Coverage (square feet per gallon)	Man- minutes (per gallon)	
Camouflage, gasoline-soluble; table IV.	500	5	600	12	For temporary use such as identification marks on vehicles, guns, aircraft, and equipment.
Cement water paint; type III; table V.	450	4 ½	525	11	
<i>Adhesives</i>					
Bituminous emulsion; table VII.	45	½	45	3	
Cutback asphalt; table VIII.	30	½	30	2	
Field-expedient green vegetation adhesive; table XXII.	(¹)	(¹)	(¹)	(¹)	Emergency use for small area such as on vehicles.
Field-expedient starch adhesive; table XXIII.	(¹)	(¹)	(¹)	(¹)	As above.

Table XLVII. Metal, Galvanized

Coating material	Brushing		Spraying		Remarks
	Coverage (square feet per gallon)	Man- hours (per gallon)	Coverage (square feet per gallon)	Man- minutes (per gallon)	
<i>Paints</i>					
Cement water paint, type III; table V.	450	4 ½	525	11	First choice.
Camouflage, oleoresinous emulsifiable; table II.	600	6	750	15	Second choice.
<i>Adhesives</i>					
Cutback asphalt; table IX.	30	½	30	2	First choice.
Bituminous emulsion; table VIII.	45	½	45	2	Second choice.

Table XLVIII. Mineral Coated Roofing

Coating material	Brushing		Spraying		Remarks
	Coverage (square feet per gallon)	Man-hours (per gallon)	Coverage (square feet per gallon)	Man-minutes (per gallon)	
<i>Paints</i>					
Camouflage, oleoresinous emulsifiable; table II.	450	4 ½	600	12	Reduce with water.
<i>Adhesives</i>					
Bituminous emulsion; table VII.	45	½	45	2	First choice.
Cutback asphalt; table VIII.	30	½	30	2	Second choice.

Table XLIX. Rubber

Coating material	Brushing		Spraying		Remarks
	Coverage (square feet per gallon)	Man-hours (per gallon)	Coverage (square feet per gallon)	Man-minutes (per gallon)	
Ready-mixed, oil type paint; table I.	400	4	475	10	First choice.
Camouflage, oleoresinous emulsifiable; table II.	450	4 ½	600	12	Second choice.

Table L. Wood

Coating material	Brushing		Spraying		Remarks
	Coverage (square feet per gallon)	Man-hours (per gallon)	Coverage (square feet per gallon)	Man-minutes (per gallon)	
<i>Paints</i>					
Ready-mixed, oil type paint; table I.	400	4	475	10	First choice. Unpainted surfaces should be primed with oil-base primer (table XI).
Oil type runway paint; table VI.	300	3	350	7	Second choice.

Table L. Wood—Continued

Coating material	Brushing		Spraying		Remarks
	Coverage (square feet per gallon)	Man- hours (per gallon)	Coverage (square feet per gallon)	Man- minutes (per gallon)	
Camouflage, oleoresinous, emulsifiable; table II.	450	4 ½	600	12	Third choice. Unpainted surface should be primed before application. For primer, see table XI.
Field-expedient emulsified paint; table XVII.	(¹)	(¹)	(¹)	(¹)	
<i>Stains</i>					
Creosote stain, ready mixed; table IX.	200	2	200	4	Cannot be painted over with an oil paint in light colors because of the staining from creosote.
Oil stain, ready-mixed; table XI.	200	2	200	4	First choice.
Asphalt stain, ready-mixed; table XI.	200	2	200	4	Cannot be painted over because the asphalt bleeds through.
<i>Adhesives</i>					
Bituminous emulsion; table VII.	45	½	45	2	
Cutback asphalt; table VIII.	30	½	30	2	
Field-expedient green vegetation adhesive; table XXII.	(²)	(²)	(²)	(²)	Emergency use on small area.
Field-expedient starch adhesive; table XXIII.	(²)	(²)	(²)	(²)	Emergency use.

¹Not available. ²Not applicable.

Table LI. Wood Chips and Other Texturing Materials

Coating material	Spraying		Asphalt distributor		Remarks
	Coverage (square feet per gallon)	Man- minutes (per gallon)	Coverage (square feet per gallon)	Applica- tion Speed (square feet per minute)	
<i>Paints</i>					
Oil-type runway paint; table VI.	150	3	150	12,000	First choice.
Camouflage oilcoresin- ous emulsifiable; table II.	300	6	300	24,000	Second choice.
<i>Stains</i>					
Creosote stain, ready- mixed; table XI.	200	4	200	16,000	
Oil stain, ready-mixed; table XI.	200	4	200	16,000	
Asphalt stain, ready- mixed; table XI.	200	4	200	16,000	

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